TRANSPORTATION

Report No. 5

EXTERNAL TRAVEL IMPACTS STUDY

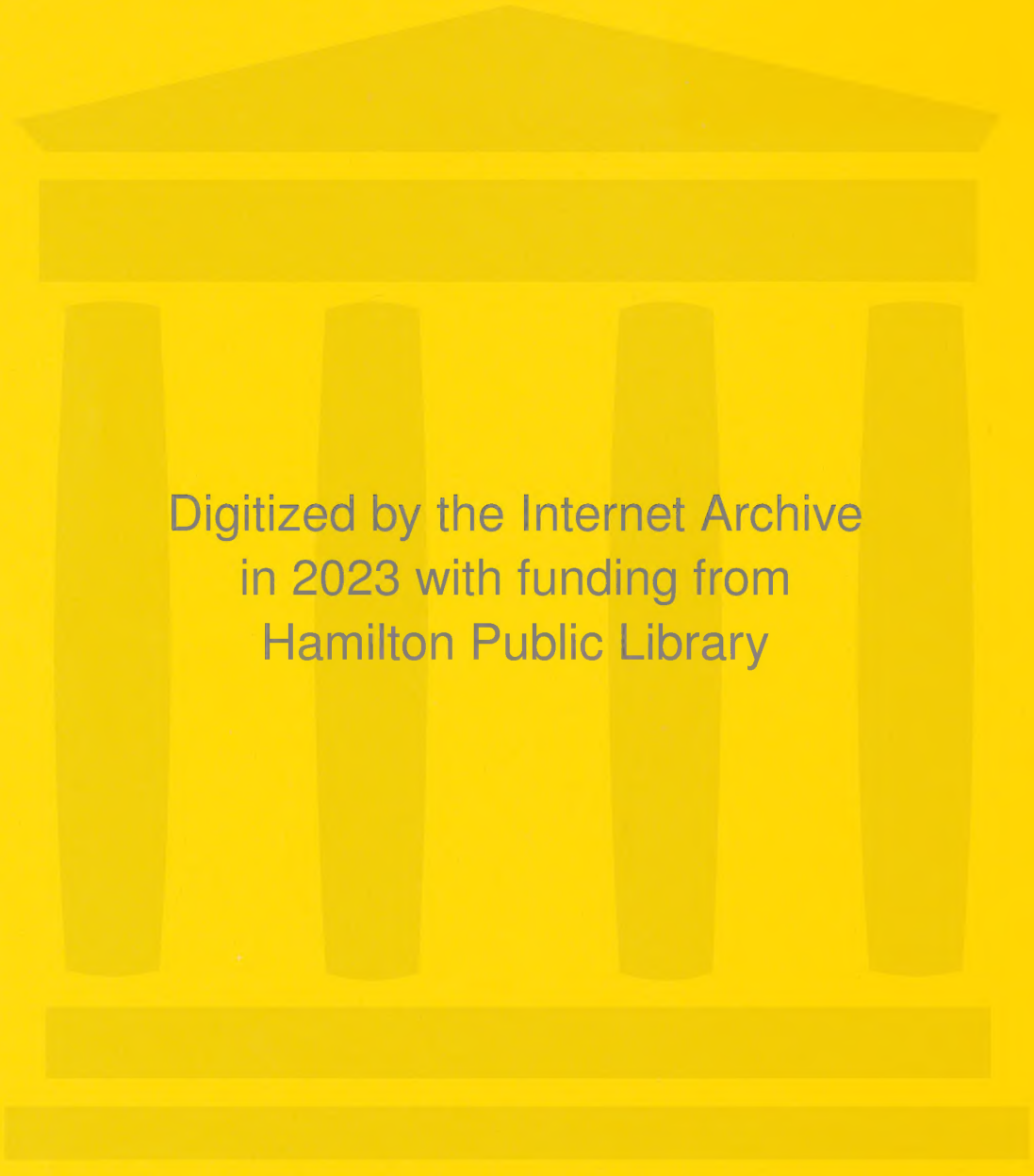
CA3ONHW 000
78 TUC

HAMILTON PUBLIC LIBRARY
3 2022 21293025 5

HAMILTON PUBLIC LIBRARY
GOVERNMENT DOCUMENTS

December, 1978

Planning & Development Department
Hamilton - Wentworth Region



Digitized by the Internet Archive
in 2023 with funding from
Hamilton Public Library

https://archive.org/details/transportationre00unse_1

TRANSPORTATION

REPORT NO. 5
EXTERNAL TRAVEL IMPACTS STUDY

REGIONAL PLAN DIVISION
PLANNING & DEVELOPMENT DEPARTMENT
REGIONAL MUNICIPALITY OF
HAMILTON-WENTWORTH

DECEMBER, 1973

SUMMARY

The External Travel Impacts Study evaluates existing and future impacts of traffic travelling into, out of or through the Region. Study results will aid in making long and short term Regional transportation planning decisions.

The study analysis was based on existing data and a comprehensive external travel survey conducted in 1976. The data was summarized to:

1) effectively describe existing travel characteristics and observed traffic flows, and

2) prepare computer simulated traffic flows of vehicles crossing the Regional boundary.

The calibrated base year travel provided a basis to forecast 2001 external traffic and to simulate 2001 traffic flows. The forecast was based on the Fratar factoring technique which utilized existing and forecasted population and employment data for predicting changes in travel patterns.

The report concludes there will be significant increases in external traffic and the capacity of a number of existing road facilities will be exceeded by the year 2001. The following road improvements will be required to serve the expected traffic volumes and to maintain Regional accessibility:

1. reconstruction of the Q.E.W. crossing the Burlington Beach Strip to increase the operating capacity,

2. immediate construction of a new arterial road crossing the Burlington Beach Strip to accommodate commuter traffic,

3. the realignment of Highway 6 south of the City of Hamilton to connect directly to the freeway system in the Region,

4. stringent access controls and capacity improvements to Highway 6 north of Highway 403,

5. the eventual expansion of Highway 403 between King Street and Highway 6,

6. the reconstruction of Burlington Street East to increase capacity,

7. the construction of the proposed Industrial Perimeter Road between Burlington Street and Highway 403, and

8. improved north-south highway capacity across the Niagara Escarpment connecting the Q.E.W. with the Hamilton mountain.

The report makes the following conclusions regarding the potential of expanding inter-regional transit connections:

1. implementation of major inter-regional transit connections has limited potential to eliminate or delay needed road improvements.

2. expansion of transit service between Burlington and Hamilton has the greatest potential for providing improved inter-regional transit travel.

However, expected commuter transit use does not appear to warrant the implementation of full GO rail service between downtown Hamilton and Toronto.

The report makes the following recommendations:

1. The findings of this study be used by the Region as a data supplement in transportation decision making.

2. The results of this study be forwarded to the Provincial Ministry of Transportation and Communications and they be requested to take appropriate action to implement the findings as they apply to Provincial highways.

3. A program be initiated to monitor external traffic and to continuously evaluate the findings and conclusions of this study.

TABLE OF CONTENTS

SECTION	TITLE	PAGE
	SUMMARY	i
	TABLE OF CONTENTS	iv
	LIST OF FIGURES	viii
	LIST OF TABLES	ix
1.0	INTRODUCTION	1
1.1	Purpose	1
1.2	Definition of External Traffic	2
1.3	Study Objectives	2
1.4	Application of Study Findings	3
1.5	Study Procedure	3
1.6	Intergovernmental Co-operation	5
2.0	SURVEY DESIGN	6
2.1	The Survey	6
2.2	The External Cordon	6
2.3	The Survey Stations	8
2.4	Data Collection Procedures	9
2.4.1	Roadside O.D. Survey	9
2.4.2	Licence Plate Survey	10
2.4.3	Survey of Trucks	10
2.5	Coding of Questionnaires	11
2.6	Traffic Zones	12
2.7	Quality Control Procedures	13

TABLE OF CONTENTS (CON'T)

SECTION	TITLE	PAGE
3.0	DATA COLLECTION SUMMARIES	15
3.1	Data Sources	15
3.2	Roadside O.D. Stations	15
3.3	Licence Plate Survey	17
3.4	Waterloo Stations	17
3.5	NLETS' Station 501	19
3.6	Summary of Trip Records	19
4.0	TRAFFIC ANALYSIS AND FORECASTING TECHNIQUES	24
4.1	Methodology	24
4.2	Preparation of Survey Records	26
4.3	Data from other Sources	28
4.4	Traffic Zone Conversions	29
4.5	The Survey Data Bank	29
4.6	Editing of Data	32
4.7	Travel Characteristics	32
4.8	Base Year O.D. Tables	33
4.9	Validity Checks	34
4.10	Travel Forecasts	35
5.0	PRESENTATION OF RESULTS	38
5.1	Travel Characteristics	38
5.1.1	Variation in Travel over Time	39
5.1.2	Travel by Purpose	42
5.1.3	Vehicle Occupancy Rates	45

TABLE OF CONTENTS (CON'T)

SECTION		TITLE	PAGE
	5.1.4	Trip Direction	48
5.2		Base Year Travel Patterns	50
	5.2.1	Traffic By Survey Station	50
	5.2.2	External Trip Ends	53
	5.2.3	Internal Trip Ends	56
	5.2.4	Through Traffic	60
	5.2.5	Traffic Routing	63
	5.2.6	Truck Traffic	65
	5.2.7	Validation	65
5.3		Horizon Year Travel Patterns	68
	5.3.1	Growth in External Travel	68
	5.3.2	Growth by Trip Generators	70
	5.3.3	Growth by Screenline	70
	5.3.4	Forecasted Traffic Routing	73
6.0		CONCLUSIONS AND RECOMMENDATIONS	75
6.1		Traffic Distribution	75
6.2		Traffic Patterns	76
6.3		Road Improvements Required	78
	6.3.1	Q.E.W. Skyway	78
	6.3.2	Highway 403	78
	6.3.3	Highway 6 North	79
	6.3.4	Highway 6 South	79
	6.3.5	Hamilton Southern Freeway Bypass	80
	6.3.6	Burlington Street East	81
	6.3.7	Industrial Perimeter Road	81

TABLE OF CONTENTS (CON'T)

SECTION		TITLE	PAGE
	6.3.8	Regional Road Connections	82
6.4		Potential Transit Connection	83
6.5		Accuracy of Forecasts	84
6.6		Recommendations	86

APPENDIX A A1

Survey Station Description

APPENDIX B A2

Survey Questionnaires

APPENDIX C A3

Fratar Factoring Technique

APPENDIX D A4

External O.D. Tables

LIST OF FIGURES

FIGURE	TITLE	PAGE
1.1	Study Activities	4
2.1	The External Cordon and Survey Stations	7
4.1	Study Analysis Procedures	25
4.2	Preparation of Base Year Data	27
5.1	Hourly Vehicle Variation	40
5.2	Hourly Vehicle Variation as a Percentage	41
5.3	Normal Weekday Distribution of Traffic by Purpose on Regional Roads and Provincial Highways	43
5.4	Normal Weekday Distribution of Traffic by Purpose on Hwy. 403 and Q.E.W.	44
5.5	Variation in Hourly Vehicle Occupancy Rates for Normal Weekday Work Trips	46
5.6	Variation in Hourly Vehicle Occupancy Rates for Normal Weekday Non-Work Trips	47
5.7	24 Hour External Traffic by Station	51
5.8	Peak Hour External Traffic by Station	52
5.9	24 Hour Destinations of External Traffic	54
5.10	Peak Hour Destinations of External Traffic	55
5.11	Traffic Screenlines	59
5.12	Two Way 24 Hour Through Traffic Interchange	61
5.13	Two Way Peak Hour Through Traffic Interchange	62
5.14	1976 Peak Hour Traffic Assignment	64
5.15	2001 Peak Hour Traffic Assignment	74

LIST OF TABLES

TABLE	TITLE	PAGE
3.1	1976 Roadside Survey Station Summary	16
3.2	Survey Response: Licence Plate Survey	18
3.3	Total Trip Records Available After Editing	20
3.4	Summary of 12 Hour Data	22
3.5	Summary of Peak Hour Data	23
4.1	Trip Record Format: 1976 Survey	30
4.2	Trip Record Format: 1971 NLETS Survey	31
5.1	Car Occupancy Summary	48
5.2	Directional Splits (Peak Period)	49
5.3	Internal Trip Ends	57
5.4	Internal Trip Ends: Peak Period	58
5.5	Percent Heavy Trucks by Station	66
5.6	1976 Observed vs. Simulated External Traffic	67
5.7	Forecast Growth in External Traffic	69
5.8	Growth by Area Inside and Outside Region	71
5.9	External Traffic Growth by Screenline	72

1.0 INTRODUCTION

1.1 PURPOSE

The External Travel Impacts Study was conducted in order to collect information on the travel patterns and behavioral characteristics of trip makers travelling into, out of, or through the Hamilton-Wentworth Region. The information from the study is utilized to better understand the impact of externally oriented travel on the transportation systems within the Hamilton-Wentworth Region and to provide a base on which to project future changes in external travel and future traffic requirements.

A previous Home Interview Travel Characteristics Survey, conducted as input to the Regional Official Plan, gathered information on the travel characteristics of persons residing in Hamilton-Wentworth and Burlington and travelling either within the study area or from within the study area to points outside the study area. The internal survey provided a sufficient base to predict the impacts of changes in development in the Hamilton-Wentworth Region on the need for improved transportation facilities within the Region. The travel forecasts based on the internal survey are sufficient for relative comparison purposes. However, for more detailed systems analysis and design it is necessary to understand the impact of all traffic on the need for new transportation facilities. Traffic generated outside the borders of the Region has a significant impact on many of the transportation connections within the Region. The External Travel Impacts Study provides information on the existing external traffic using the transportation systems in the Region and provides a base by which to forecast the changes in external traffic relative to changes in development within and outside of the Regional Municipality of Hamilton-Wentworth.

1.2 DEFINITION OF EXTERNAL TRAFFIC

External traffic is comprised of trips made in either private autos, trucks or transit that have at least one trip end outside of the Region but have some portion of the trip within the Region. External destined traffic is comprised of trips that have one trip end within the Hamilton-Wentworth Region and the other trip end outside the Region. External through traffic is comprised of trips that start and end outside the Region with a portion of the trip passing through the Region.

1.3 STUDY OBJECTIVES

The goal of the External Travel Impacts Study was to assess the impacts of externally oriented traffic on the Regional transportation system both now and in the future. In order to achieve this goal it was important to define specific objectives for the study. These objectives are:

1. To establish a measure of the travel characteristics of external trip makers.

2. To establish causal relationships between trip making and land use activity measures.

3. To establish the existing external traffic patterns.

4. To project future external traffic patterns.

1.4 APPLICATION OF STUDY FINDINGS

The output of this study is a detailed analysis of the existing external traffic within the Region and a forecast of how this traffic will change up to the year 2001. This information is summarized to provide an overview of the impacts of external traffic. A data base will be maintained so that more detailed summaries can be developed for studies of specific projects within the Region. This information will be used as input for:

a) monitoring the impacts of the Regional Official Plan transportation policies,

b) measuring the impact of external traffic on specific sections of road within the transportation network,

c) the study of the need for possible highway by-pass routes around urban areas,

d) the study of new or improved regional and inter-regional road connections,

e) the study of the potential for inter-regional transit connections.

1.5 STUDY PROCEDURE

Figure 1.1 is a flow diagram showing the sequence of major activities undertaken in the study. Once the goal and objectives of the study were determined a detailed study design was prepared.

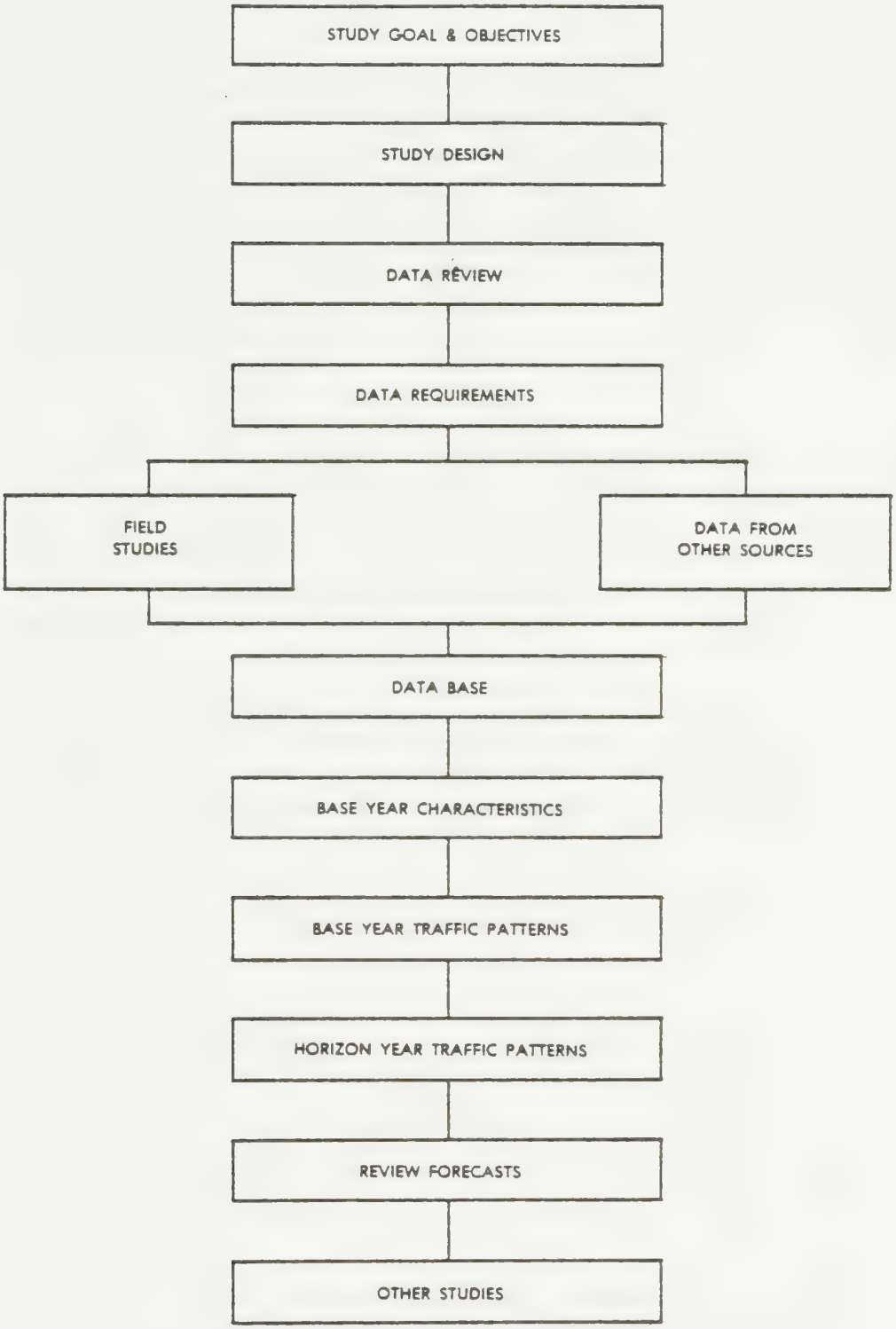


FIGURE 1.1: STUDY ACTIVITIES

The study is dependent upon a comprehensive data base of external travel characteristics. Because data collection is expensive and time consuming a review of all past studies and available data was done. There was some existing data that could be updated and utilized in the study. However, it was necessary to conduct a major field survey to collect the majority of information on external trip makers. The data collection survey is described in Chapter Two.

The combined data from the survey and all other sources was utilized to analyze base year travel characteristics. The data was also utilized to establish relationships between trip making characteristics and measures of land use. Base year traffic patterns were established and horizon year forecasts were then made.

The analysis procedures are described in Chapter Three. Chapter Four summarizes the sample data from the survey and other sources and Chapter Five contains the study findings.

1.6 INTERGOVERNMENTAL COOPERATION

This study was done as a joint project by the Regional Municipality of Hamilton-Wentworth Planning and Development Department and the Provincial Ministry of Transportation and Communications (M.T.C.), Municipal Planning Branch. The study provides information for Regional planning purposes and for Provincial planning purposes.

The study tasks were divided between staffs of the Region and the M.T.C. The Ministry staff were responsible for all the field work and the development of computer programs utilized in the analysis. The Region was responsible for coding the survey data, keypunching the data, analysis of travel data, developing the travel forecast methodology, applying this methodology and preparing the study report.

2.0 SURVEY DESIGN

2.1 THE SURVEY

The External Cordon Travel Characteristics Survey was designed to collect information from a representative sample of travel starting and/or ending outside the Region but having some portion of travel within the boundaries of the Region. Information collected has to be sufficient to determine where the trip starts and ends, the purpose of the trip, the number of persons making the trip, the frequency of the trip, and other characteristics of the trip and the trip maker.

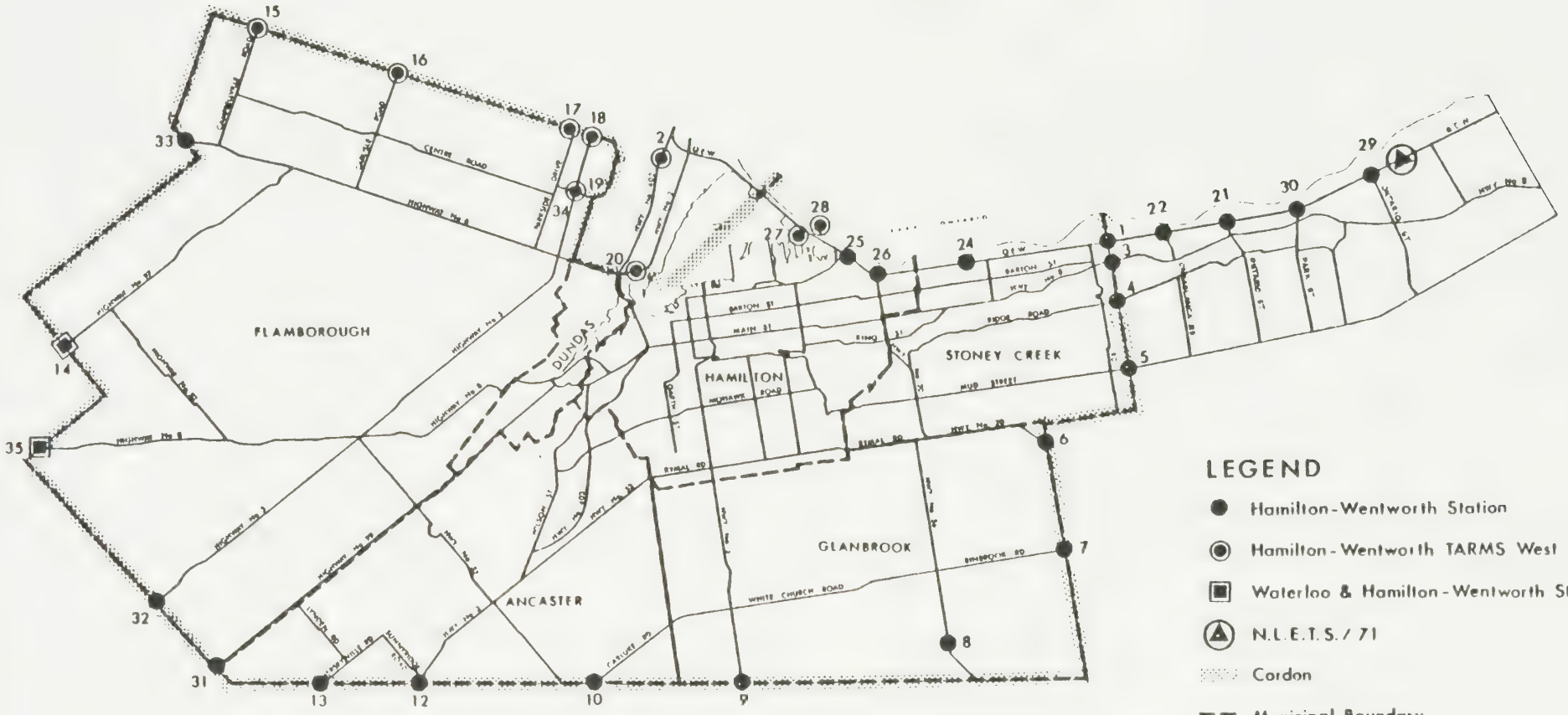
Additional information had to be collected on all external travel in order to determine how representative the sample of information of external traffic characteristics is and to develop factors for expanding the sample to represent all external traffic in the Region. The information on trip makers was collected in July 1976 with information on trips passing any specific point collected for a twelve hour period from 7 a.m. to 7 p.m. on a typical week day.

2.2 THE EXTERNAL CORDON

The survey collected data from a sample of traffic on every major road crossing the external cordon line. For this study, the external cordon is formed at the municipal boundary of the Region of Hamilton-Wentworth and the data collection points were established as close as possible to the point where the road crossed the boundary. The external cordon and the survey stations are shown in Figure 2.1. A detailed description of each of the external cordon stations in given in Appendix A.

Fig. 2.1

EXTERNAL CORDON AND SURVEY STATIONS



LEGEND

- Hamilton-Wentworth Station
- Hamilton-Wentworth TARMS West Cordon
- Waterloo & Hamilton-Wentworth Station
- N.L.E.T.S./71
- Cordon
- Municipal Boundary

NOT TO SCALE
Nov. 1978

PLANNING & DEVELOPMENT DEPARTMENT
HAMILTON WENTWORTH REGION

2.3 THE SURVEY STATIONS

External travel data for private automobiles was collected at 31 stations. Data on truck traffic was also collected at 31 stations. The station locations are shown in Figure 2.1.

Information was collected only for those roads crossing the Regional boundary with more than 500 vehicles per average day travelling on them. In addition, any station that had had an origin-destination survey conducted at or near that location within the last five years utilized the previous information and the survey process was not repeated. The effect of these decisions on the survey accuracy was judged to be insignificant.

A number of the external cordon stations were utilized for more than one study. Stations 15, 16, 17, 18, 19, and 20 as shown in Figure 2.1 were utilized in a larger roadside survey being conducted for the Toronto Area Regional Model Study (TARMS). The Region of Waterloo conducted an external survey at the same time and stations 14 and 35 of this survey collected information for both the Hamilton-Wentworth and Waterloo surveys.

A previous study had collected travel characteristics information for traffic on the Q.E.W. near the eastern end of the Region. This was station 501 of the Niagara Lake Erie Transportation Study (NLETS). This station was located in the Regional Municipality of Niagara at Niagara Regional Road No. 22. The information from that survey station had to be modified to represent travel at the Hamilton-Wentworth boundary. In order to do this, it was necessary to collect data on all traffic leaving the Q.E.W. between the Regional boundary and this station. This information was collected at stations 21, 22, 29, and 30 which were located on the east bound off ramps from the Q.E.W. at the Ontario Street Interchange (Grimsby), the Casablanca Road Interchange, the Ontario Street Interchange (Beamsville) and the Park Road interchange.

2.4 DATA COLLECTION PROCEDURES

Two distinct types of information were collected in the External Cordon Survey. The first was basic vehicle count information. Automatic roadside counts were taken at each of the stations for a seven day period during the roadside O.D. survey. These counts were taken for all traffic in both directions and summarized for hourly time periods. As part of the vehicle count a one day vehicle classification count was done for all traffic travelling in both directions at each station.

The second type of data collected concerned the travel characteristics of the trip makers passing each traffic count station. This was accomplished by asking a sample of vehicle drivers to complete a questionnaire giving information on where their trip started and would end, the purpose of the trip, the time duration, and frequency of the trip. Examples of the different questionnaires used in this survey are contained in Appendix B. The sample of drivers completing a questionnaire was collected over a twelve hour period from 7.a.m. to 7 p.m. on a typical weekday at each station.

Because of time and financial constraints, it was decided that travel characteristics would be collected only for traffic travelling in the outbound direction at each station (traffic passing the station leaving the Region).

2.4.1 ROADSIDE O.D. SURVEY

Travel characteristics were collected using standard roadside interview techniques except for those stations located on Freeways (Station 25 on the Q.E.W. and Station 2 on Highway 403). The standard roadside technique involved stopping a sample of vehicles passing the station and asking the driver and passengers in the vehicle

questions about their trip. On rural roads with lower traffic volumes a survey team of six (6) interviewers and one (1) party chief was required to conduct the survey. On roads with higher traffic volumes two survey teams were required at each station. The roadside surveys were carried out during the month of July in 1976 with one or two stations done in each weekday.

The roadside survey sample rate was not constant. The field staff tried to interview the occupants of as many vehicles as possible, with a 100 percent sample rate being obtained at some stations during the off peak hours. When vehicle volumes increased to a rate beyond which a one hundred percent sample could be obtained a random sample of vehicle was stopped and the occupants were interviewed. As a result the sample rate decreases as the volume of traffic increases.

2.4.2 LICENCE PLATE SURVEY

The stations on the Q.E.W. and Highway 403 could not be safely surveyed using the standard roadside interview technique because of the high volumes of traffic and high speed of traffic movement. At these stations a licence plate trace was conducted where the survey crews recorded a sample of licence plate numbers of vehicles passing the station in an outbound direction over a twelve hour period on a standard week day. Ministry of Transportation and Communication's computer files were utilized to obtain the name and address of the vehicle owners and a questionnaire was mailed out to the owner asking questions about his trip on the survey day. A sample of the questionnaires is contained in Appendix B. The questionnaire, once completed by the vehicle owner, was mailed back to the Region for processing.

2.4.3 SURVEY OF TRUCKS

Information on the traffic movements of large trucks was collected at all roadside interview stations and also on the Q.E.W. and Highway 403.

Information on trucks was collected for all trucks with 2 or more axles. Because truck traffic represents a significant portion of traffic on the Q.E.W., it was decided to set up an additional station to collect information on truck traffic at that point. This is station 24 located at the truck weigh scale station on the Q.E.W. (as shown in Figure 2.1).

2.5 CODING OF QUESTIONNAIRES

The information obtained from each survey sample was coded in such a manner that it could be analyzed rapidly with the aid of an electronic computer. The coding of this information was done in a purely numerical format.

The survey questionnaire forms were designed so that the information recorded at the roadside survey stations could be coded directly on the form. The coding of all information was straight forward except for those questions involving geographic locations (i.e. trip ends). During the survey, geographic locations were recorded as street addresses, name of a prominent building, or description of closest major intersections. This geographic data was numerically coded into the appropriate zones utilizing the TARMS traffic zone number and the Provincial Code Zone number in which the address is located. The zone systems utilized are described in Section 2.6.

The coding of the survey data required three employees over a time period of four months of intensive work. A total of 22,100 survey questionnaires were coded for 28 survey stations for the Hamilton-Wentworth Survey. The two stations common with the Waterloo survey were coded by Waterloo staff. Station 501 of the Niagara Lake Erie Transportation study had been previously coded. The survey information was coded in accordance with the M.T.C. manual for coding travel characteristic survey information.

The data, once coded in a numerical format, was keypunched on computer data cards with the information from each vehicle surveyed contained on one computer keypunch card. A total of approximately 21,600 computer cards were keypunched for the Hamilton-Wentworth Survey. There were 500 questionnaires with insufficient data to code and keypunch.

For analytical purposes the information collected on trucks varied slightly from the information collected on other vehicles. In addition to the usual origin-destination information, data on vehicle weights and load type was obtained. Origin-destination information for trucks was coded on special forms and dealt with separately throughout the study. A sample survey form for truck interviews is shown in Appendix B.

2.6 TRAFFIC ZONES

The geographic locations of trip ends were numerically coded to traffic zones. In order to facilitate the data analysis the study area was divided into three (3) previously established zone systems. This was necessary because information was obtained from different sources and the available zone systems varied considerably throughout the Province. The principal zone system used in coding the survey was the zone system established for the Toronto Area Regional Model Study (TARMS).

The TARMS zone system is Toronto oriented in that zones tend to be smallest inside Metro Toronto. Zones which are further from Metro, or which have a lower intensity of land use, are larger in size. The Hamilton-Wentworth Region is located on the edge of the TARMS detailed study area and TARMS zones immediately to the north, south, and west of the Region were too large for this study's purposes. For this reason, another set of zones called Provincial code zones were

coded for each trip record. Zones in this system are of approximately equal area, and cities the size of Hamilton are usually contained in only one zone. Consequently, these zones also tend to be too large in some areas. By combining these two zone systems, it was felt that an acceptable level of detail could be achieved anywhere in Ontario. The third zone system, called the Hamilton-Wentworth External Zone System, is an aggregation of TARMS zones in areas where there is no need for the same level of detail and a disaggregation of TARMS zones in areas where a greater level of detail was required.

Information regarding east bound vehicles on the Niagara Q.E.W. was obtained from a survey station coded in 1971 for the NLETS area. The NLETS zones were developed for a study in the Niagara Peninsula so the smallest zones are contained in eastern Niagara and the largest zones located north and east of Hamilton-Wentworth. It was necessary to convert the NLETS zones to a temporary zone system which was later adjusted to obtain the necessary compatability with the Hamilton-Wentworth External Zone System.

2.7 QUALITY CONTROL PROCEDURES

In order to insure survey accuracy, checks were performed during all stages of the data preparation. After field crews interviewed trip makers, their supervisor would complete an initial check of the interview forms to make sure that all of the required information was obtained. Once this was complete interview forms were placed in an envelope and sent to the Region. Here, interviews were transcribed from a written format to a numerical formal called a trip record. Wherever information was missing or indecipherable, coding personnel would attempt to correct the record. However, if it was not possible to correct, then the record was

rejected. Records were again randomly checked by the supervisor of the coding personnel and sent to the M.T.C. At the Ministry, forms again were checked for numerical consistency and randomly checked for coding accuracy. Records were then sent out to be keypunched. Returned trip record computer cards were verified by comparing them with the original trip record.

3.0 DATA COLLECTION SUMMARIES

3.1 DATA SOURCES

The origin-destination (O.D.) survey data was obtained from a number of different sources. The two main sources were the 1976 surveys and the 1971 NLETS survey. There were, however, variations in the type and amount of survey data obtained at the different stations in the 1976 survey.

The 1976 surveys collected data at 31 separate stations (as shown in Figure 2.1). At the majority of stations data was collected for both private autos and trucks in the outbound direction only (vehicles leaving the Region). At stations 24 and 26, O.D. data was collected for trucks only. A vehicle classification count was done at station 1 but no O.D. survey data was collected here. At stations 15, 16, 17, 18, 19 and 20, used by M.T.C. staff for a TARMS survey, O.D. data was collected for both inbound and outbound vehicles. Similarly, at stations 14 and 35, utilized in a Waterloo study, O.D. information was collected for vehicles in both directions.

3.2 ROADSIDE O.D. STATIONS

Table 3.1 is a summary of private automobile data collected at roadside survey stations and coded by Regional staff. The difference between the number of interviews and the number of records represents those interviews eliminated in the coding and editing process.

In total, 16,183 trip records were created for these stations. It was necessary to then eliminate all those trips in the inbound direction so that the data would be consistent for all stations. This left 12,478 records representing outbound trips.

TABLE 3.1

1976 ROADSIDE SURVEY STATION SUMMARY

STATION	ROAD TYPE	VEHICLES		INTERVIEWS		RECORDS	
		IN	OUT	IN	OUT	IN	OUT
3	Hwy.		2,110		964		958
4	R.R.		155		44		44
5	R.R.		422		305		301
6	Hwy.		1,856		702		696
7	R.R.		832		253		251
8	Hwy.		1,590		599		575
9	Hwy.		4,033		1,233		1,233
10	R.R.		218		158		158
12	Hwy.		5,848		1,210		1,209
13	R.R.		176		122		120
15	R.R.	346	353	153	191	149	189
16	R.R.	356	357	222	242	228	233
17	R.R.	221	223	167	147	157	149
18	Hwy.	3,321	3,202	502	530	499	527
19	R.R.	1,527	1,347	454	450	455	448
20	Hwy.	7,047	6,343	1,305	1,093	1,305	1,093
21	Ramp		1,249		657		652
22	Ramp		1,067		579		569
28	R.R.	3,519	3,856	915	1,081	912	1,070
29	Ramp		790		419		419
30	Ramp		409		279		277
31	Hwy.		569		319		319
32	Hwy.		556		227		221
33	Hwy.		3,457		769		767
TOTALS						3,705	12,478

HWY .... Provincial Highway
R.R. ... Regional Road
Ramp ... Interchange Ramp to Q.E.W.

3.3 LICENCE PLATE SURVEY

As described in Section 2.4.2, origin-destination data was collected at station 2 on Highway 403 and at station 27 on the Q.E.W. skyway by means of a license plate trace. Table 3.2 shows the response rate from these two stations and the final representation of the survey sample. The sample size is lower than other stations because of the data collection procedures. First, only vehicles with Ontario licence plates could be sampled, due to the available source of drivers addresses. Secondly, some licence plates could not be traced and others that were traced could not be used because the owner was a rental company, etc. Thirdly, the vehicle owners had a choice as to whether they would complete and return the questionnaires. Less than 40% of the questionnaires mailed out were completed and returned. The number of errors in the questionnaires was higher than for the O.D. survey because the questionnaires were completed without supervision.

The survey response was much less on the Skyway than on Highway 403. This was partly due to the heavy traffic conditions and partly due to the safety of the field crew location on the Skyway.

A more detailed description of the analysis of the licence plate survey is contained in the 1976 O.D. Survey Synopsis Report prepared by M.T.C. staff.

3.4 WATERLOO STATIONS

The two stations (14 and 35) that were on the boundary with the Waterloo Region were coded and edited by Waterloo staff. The information was forwarded to Hamilton-Wentworth staff in the form of trip records on a computer tape. The records were verified and edited by Waterloo staff before being sent to Hamilton-Wentworth, therefore there is no summary available on the original questionnaires and the amount of data lost in the editing process.

TABLE 3.2

SURVEY RESPONSE

LICENCE PLATE SURVEY

ITEM	HWY. 403	SKYWAY
Total Vehicle Count	18,501	20,683
Ontario Licence Plates	13,921	13,056
Licence Plates Recorded	9,898	6,700
Licence Plates Matched	8,419	5,777
Questionnaires Mailed Out	7,285	4,964
Questionnaires Returned	2,910	1,761
Uncodable	191	123
Questionnaires Coded	2,719	1,638
Eliminated Through Editing	181	123
Survey Records	2,538	1,515
Sample Representation	13.7%	7.3%

The data from Waterloo contained a total of 764 private auto trip records. Of these, 165 were inbound and 599 were outbound. The inbound records were later removed to make the data consistent with the other stations.

3.5 NLETS STATION 501

Origin-destination information about trips outbound on the Q.E.W. towards Niagara was obtained from station 501 of the NLETS survey conducted in 1971. The data from this station was in the form of trip records on a computer tape file. The data was previously coded and edited and was ready for analysis.

There were a total of 5,913 trip records on the NLETS file. Outbound records on the file account for 2,913 trip records, with 3,000 inbound trip records.

The NLETS survey did not collect all the same information as the 1976 survey. Therefore, it was necessary to create a separate data bank for the NLETS trip records.

3.6 SUMMARY OF TRIP RECORDS

Table 3.3 is a summary of all trip records available from all sources after the necessary editing of the trip record files. There were a total of 26,913 trip records representing private automobile trips. Of these 6,870 had to be eliminated because they represented inbound trips, leaving 20,043 auto trip records utilized in the study analysis.

TABLE 3.3

TOTAL TRIP RECORDS AVAILABLE AFTER EDITING

	AUTO			TRUCK		
	OUTBOUND & INBOUND RECORDS	INBOUND INBOUND RECORDS	OUTBOUND RECORDS	OUTBOUND & INBOUND RECORDS	INBOUND RECORDS	OUTBOUND RECORDS
H-W Roadside Records	14,266	3,705	10,561	1,564	108	1,456
H-W License Plate Records	4,053	DNC	4,053	DNC	DNC	DNC
Waterloo Study Records	764	165	599	72	23	49
NLETS 1971 Records	5,913	3,000	2,913	863	427	436
Q.E.W. Ramp Records	1,917	DNC	1,917	*	*	*
TOTAL RECORDS	26,913	6,870	20,043	2,499	558	1,941

DNC - DATA NOT COLLECTED

* - DATA INCLUDED IN H-W ROADSIDE INTERVIEWS

Similarly, there were 2,499 trip records representing truck traffic. After eliminating inbound trips, 1,941 trip records were left for analysis purposes.

Table 3.4 is a summary of the outbound trip records from all sources. The trip records represent a 12 hour time period from 7:00 a.m. to 7:00 p.m. The results of the 1976 survey coded and edited by Regional staff have been grouped for Provincial Highways, Regional Roads and Q.E.W. ramps for purposes of this display.

Row 6 shows the average sample size of each of the survey categories. The sample rate varied from a high of 54.5% on the Q.E.W. ramps to a low of 7.3% at the Q.E.W. Skyway. The sample rate generally varied inversely with the volume of vehicles. The sample rate was also considerably lower at those stations surveyed by means of a license plate trace.

Table 3.5 is a summary of the survey records in the p.m. peak period. This table shows that the sample rate is more consistent in the peak period. The sample rate on the Q.E.W. and Hwy. 403 are almost double the 12 hour sample rate. The sample rate at the other stations vary slightly between the peak period and the 12 hour period. The peak hour sample rate is important since the base year peak period and a forecast of the horizon year peak period will be used in assessing road requirements.

TABLE 3.4

SUMMARY OF 12 HOUR DATA

	REGIONAL ROADS	PROVINCIAL HIGHWAYS	HIGHWAY 403	Q.E.W.	Q.E.W. RAMP	FROM WATERLOO	FROM NLETS
1. Codable Vehicle Trip Interviews	2,993	7,613	DNA	DNA	1,931	DNA	DNA
2. Uncodable Vehicle Trip Interviews	245	390	191	123	97	DNA	DNA
3. Total Interviews	3,238	8,003	2,729	1,638	2,028	DNA	DNA
4. Vehicle Trip Records	2,963	7,598	2,538	1,515	1,917	599	1,913
5. Sample Lost	8.5%	5.1%	7.0%	7.5%	5.4%	DNA	DNA
6. Sample Size	37.3%	25.7%	13.7%	7.3%	54.5%	24.9%	DNA
7. Vehicles in Classification Count	7,939	29,564	18,501	20,683	3,515	2,403	DNA

DNA: Data not available. Either the data was collected in another study or the type of survey does not permit the extraction of equivalent data.

TABLE 3.5

SUMMARY OF PEAK HOUR DATA

	REGIONAL ROADS	PROVINCIAL HIGHWAYS	HIGHWAY 403	Q.E.W.	Q.E.W. RAMP	FROM WATERLOO	FROM NIETS
1. Codable Vehicle Trip Interviews	635	1,775	DNA	DNA	568	DNA	DNA
2. Uncodable Vehicle Trip Interviews	60	76	1	10	26	DNA	DNA
3. Total Interviews	695	1,851	455	345	594	DNA	DNA
4. Vehicle Trip Records	631	1,760	454	342	562	125	1,600
5. Sample Lost	9.2%	4.9%	0.2%	1.0%	5.3%	DNA	DNA
6. Sample Size	26.5%	25.2%	21.6%	13.2%	46.2%	27.1%	DNA
7. Vehicles in Classification Count	2,382	6,992	2,099	2,678	1,217	461	DNA

DNA: Data not available. Either the data was collected in another study or the type of survey did not permit the extraction of equivalent information.

4.0 TRAFFIC ANALYSIS AND FORECASTING TECHNIQUES

4.1 METHODOLOGY

Figure 4.1 is a flow diagram of the major analytical activities performed during the study. The analysis can be described under three principal headings: data preparation, base year calibration of external travel patterns and forecasts of future (year 2001) travel patterns.

The data analysis, because of the vast amount of data involved, required the use of a high speed electronic computer. The data from the roadside O.D. surveys, the automatic counts and the vehicle classification counts were keypunched and then entered on computer tapes for easy access by the computer.

The data preparation was completed in two parts. Staff at the M.T.C. were responsible for the initial analysis. They created the computer tapes, prepared standard summaries of the survey data and calculated the expansion factors that were added to each trip record on file.

The Regional staff were responsible for the rest of the data analysis. Survey records with the expansion factors were assembled into a standard data bank format. From this data bank all summaries of basic trip making and travel characteristics were prepared. Next, origin-destination tables were created for each station to represent both the p.m. peak hour travel and the 24 hour annual average daily traffic

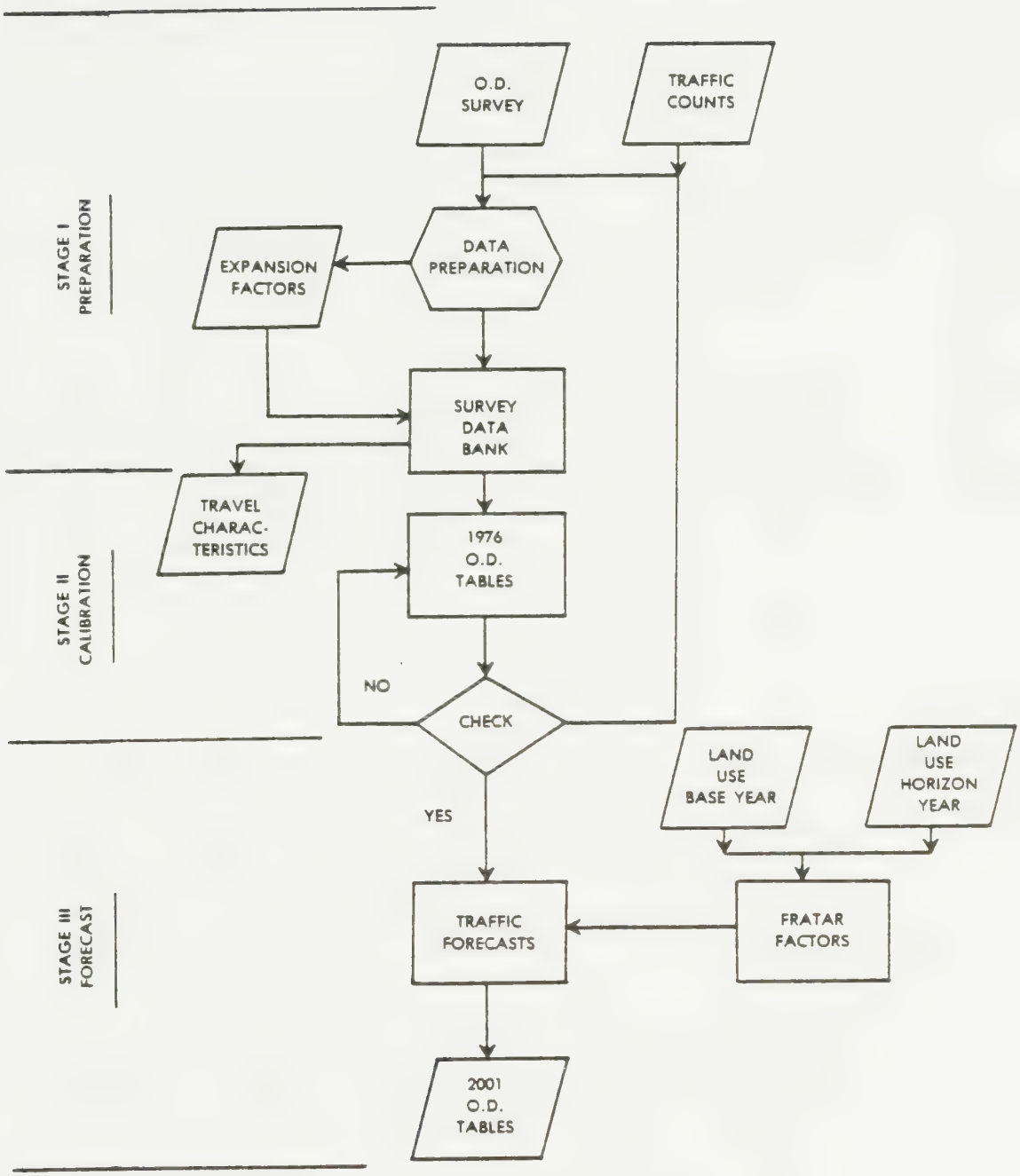


FIGURE 4.1 STUDY ANALYSIS PROCEDURES

(AADT).[1] These tables were checked and calibrated on a station-by-station basis against standard count information taken at the time of the survey.

Once the base year O.D. tables were calibrated they were combined to produce one p.m. peak hour table and one 24 hour table representing all external traffic passing all stations. Both these trip tables were assigned to the road network in order to determine the impact of external traffic on the internal road system.

The base year table was used as input to calculate origin-destination tables for the year 2001. These tables were assigned to the road network in order to better understand the possible future impacts of external traffic on the road network.

4.2 PREPARATION OF SURVEY RECORDS

A flow diagram of base year data preparation is shown in Figure 4.2. The principal input to the analysis is the trip records from the 1976 roadside and licence plate O.D. surveys. The traffic counts done in conjunction with the survey were also input to the survey analysis.

The first major step in data analysis was to calculate the factors by which the survey sample must be expanded in order to represent a one hundred percent sample of all traffic.

---

1. An origin-destination table (O.D. table) is a square table of numerical entries. The number of entries is equal to the square of the number of traffic zones used in the study. Each numerical entry indicates the number of trips between a specific origin zone and a specific destination zone over a specified period of time.

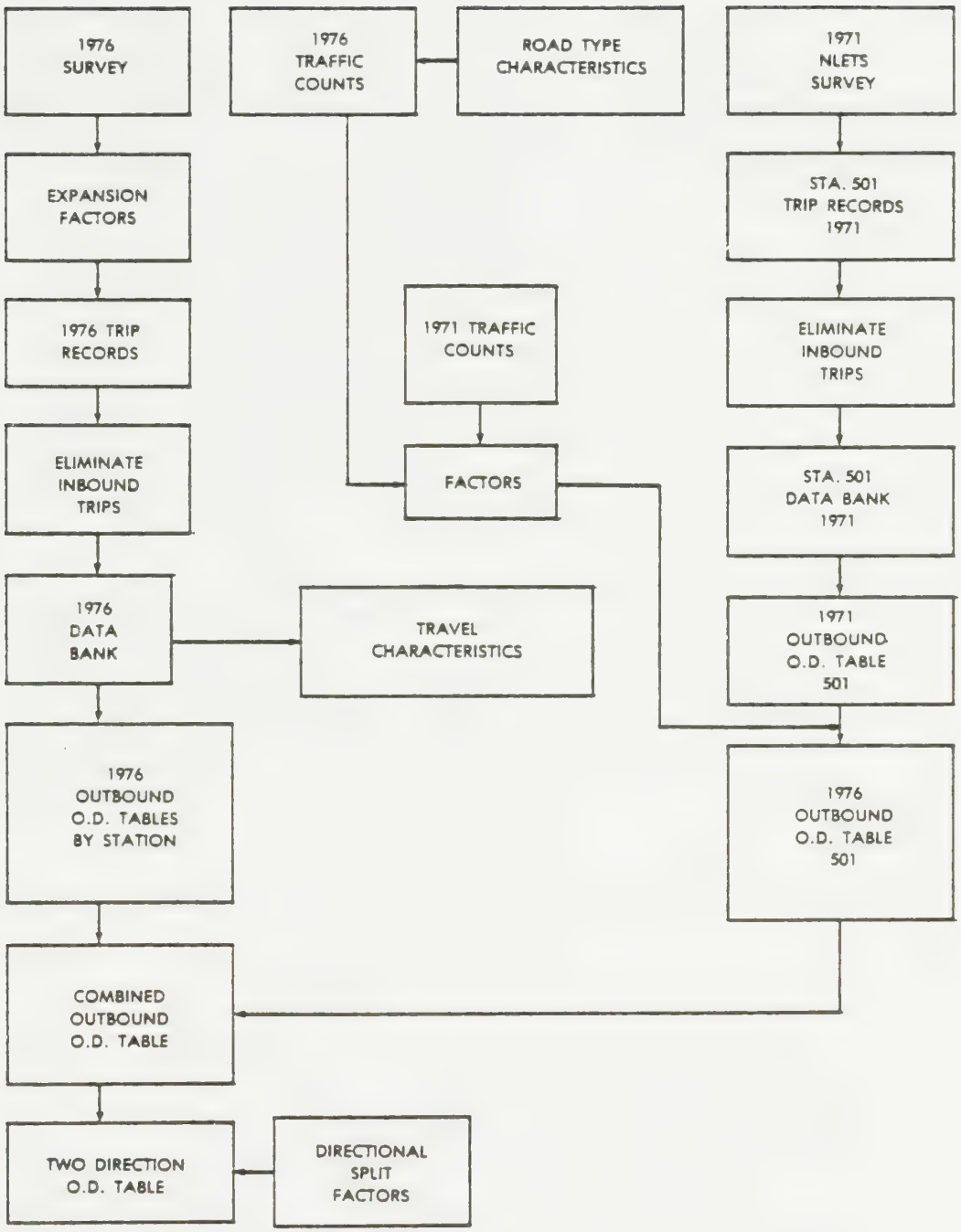


FIGURE 4.2 PREPARATION OF BASE YEAR DATA

The expansion factors were calculated using the O.D. survey record file, the hourly summary of the traffic counts and standard characteristics of road types for each station. Three expansion factors were calculated so that the sample could be expanded to represent either the Average Annual Daily Traffic (A.A.D.T.), the Summer Average Weekday Traffic (S.A.W.T.), and the Summer Average Daily Traffic (S.A.D.T.). The expansion factors were calculated on an hourly basis for the outbound direction at each station. The three expansion factors for the appropriate hour were recorded on each trip record. Factors for the expansion of the survey for truck traffic were calculated separately from the automobile traffic.

The calculation of expansion factors was done by M.T.C. staff. They also sorted the survey records by station and origin-destination pair. Information was summarized about the persons per vehicle, vehicles by type, trips by purpose, total trips and the number of trip records.

4.3 DATA FROM OTHER SOURCES

Origin-destination records for this study were obtained from three different surveys completed in two different time periods. The majority of stations depicted in Figure 2.1 were surveyed specifically for the Hamilton-Wentworth study and information was collected in the outbound direction only. Those stations that were common with the TARMS survey and the Waterloo survey, as described in Section 2.3, collected data in both directions. Origin-destination information from the NLETS survey was for 1971 traffic in both directions. It was necessary to eliminate records for inbound trips from these stations. Information from the NLETS survey had to be stored in a separate data bank because of data incompatibility with the other sources.

4.4 TRAFFIC ZONE CONVERSIONS

The trip records contained information on trip origin and trip destination in three different zone systems, as described in Section 2.6. These three zone systems were not compatible and none of them gave a reasonable level of detail for analyzing and forecasting external traffic in Hamilton-Wentworth. It was therefore necessary to convert all trip end data to a common zone system using the Hamilton-Wentworth zones.

Equivalency tables were established to convert from the TARMS, the NLETS and the Provincial Code zones to the Hamilton-Wentworth zones. For the 1976 survey, it was necessary to establish an interim zone system combining the TARMS and the Provincial Code system using whichever system had the more detailed zones in any specific geographic area. The origin and destination fields used for all further analysis are in fields 32 and 34 respectively in the survey records.

4.5 THE SURVEY DATA BANK

There are approximately 29,000 trip records stored in the base year data banks. The format of these trip records is shown in Tables 4.1 and 4.2. Records in the data bank are sorted in order of station and direction.

The 1971 NLETS survey did not contain all the information collected in the 1976 surveys, therefore, a separate data bank was constructed for station 501 from NLETS. Where possible, records were adjusted to conform to the 1976 survey information.

TABLE 4.1 TRIP RECORD FORMAT

1976 SURVEY

FIELD NO.	DESCRIPTION	COLUMN NO.
1	Page No.	1-3
2	Study No.	4-6
3	Station	7-8
4	Direction	9
5	Time Ending	10-13
6	Day, Month, Year	14-19
7	Line	20
8	Vehicle Type	21-22
9	No. in Vehicle	23-24
10	Provincial Code Origin	25-30
11	TARMS Origin	31-34
12	Establishment at Origin	35-36
13	Provincial Code Destination	37-42
14	TARMS Destination	43-46
15	Establishment at Destination	47-48
16	Driver Purpose	49-50
17	Driver Change Mode	51
18	Passenger Purpose	52-53
19	Passenger Change Mode	54
20	Duration	55
21	Home Base	56
22	Frequency	57-58
23	Factor 1 (A.A.D.T. Base)	59-62
24	Factor 2 (S.A.W.D. Base)	63-66
25	Factor 3 (S.A.D.T. Base)	67-70
26	Blank	71-72
27	Sequence	73-78
28	Driver Seat Belt	79
29	Passenger Seat Belt	80
30	Blank	81-85
31	Combined Origin Zone	86-90
32	H-W Origin Zone	91-95
33	Combined Destination Zone	96-100
34	H-W Destination Zone	101-105

TABLE 4.2 TRIP RECORD FORMAT

1971 NLETS SURVEY

FIELD NO.	DESCRIPTION	COLUMN NO.
1	Page No.	1-3
2	Study No.	4-6
3	Station	7-9
4	Direction	10
5	Time Ending	11-14
6	Day, Month, Year	15-20
7	Line	21
8	Vehicle Type	22-23
9	No. in Vehicle	24-25
10	Blank	26-31
11	NLETS Origin	32-36
12	Establishment at Origin	37-38
13	Blank	39-44
14	NLETS Destination	45-49
15	Establishment at Destination	50-51
16	Purpose	52-53
17	Blank	54
18	Blank	55-56
19	Blank	57
20	Blank	58
21	Home Base	59
22	Blank	60-61
23	Factor 1 (A.A.D.T. Base)	62-65
24	Blank	66-69
25	Factor 3 (S.A.D.T. Base)	70-73
26	Blank	74-75
27	Sequence	76-81
28	Blank	82
29	Blank	83
30	Blank	84-88
31	NLETS Origin Zone	89-93
32	H-W Origin Zone	94-98
33	NLETS Destination Zone	99-103
34	H-W Destination Zone	104-108

Where information was not available gaps were left in the survey records so that both data banks had the same record format.

4.6 EDITING OF DATA

The survey records were edited for errors at a number of points during the analysis. As described in Section 2.7, the survey forms were checked for inconsistencies before, during and after the coding process. Once the data banks were created, Regional staff rechecked the data to be sure that all data was entered in the right record columns. Data was also checked to be sure that each entry in each record field was within acceptable numerical limits.

4.7 TRAVEL CHARACTERISTICS

Once the data banks were edited, a series of stratifications were completed to obtain a better understanding of trip maker characteristics. Stratifications in this study are two, three, or four dimensional tables of grouped information from the trip records. These tables were used as a means of aggregating data to show the generalized characteristics of trip makers. In most cases information was developed by station for each hour of the twelve hour interview period.

Stratifications were prepared to show the variation of:

- trip purpose over time

- car occupancy over time

- car occupancy by trip purpose

- trip purpose by establishment at origin

- trip purpose by establishment at destination and others.

4.3 BASE YEAR O.D. TABLES

Origin-destination (O.D.) tables were developed for each station on the external cordon. Peak hour tables were developed to represent the 4:30 p.m. to 5:30 p.m. peak and 24 hour tables were developed to represent the Average Annual Daily Traffic (A.A.D.T.) conditions. All tables were developed to represent 1976 vehicle volumes.

The 1971 NLETS survey information was used to represent traffic conditions on the Q.E.W. towards Niagara. It was necessary to adjust the data from this station to represent 1976 traffic conditions so that it was compatible with the data for other stations. An O.D. table was constructed to represent the 1971 traffic at this station. This O.D. table was adjusted to represent 1976 conditions based on the ratio of the 1976 to the 1971 A.A.D.T.'s at the station location. Since the 1971 NLETS station 501 was not at the Regional Boundary but on the east side of Ontario Street in Grimsby, it was necessary to adjust the O.D. table constructed for that station to represent traffic conditions at the boundary. In order to accomplish this, the 1976 O.D. table for station 501 was combined with the O.D. tables representing 1976 traffic at the five ramps off the Q.E.W. between station 501 and the Regional boundary and all trips starting in Niagara were eliminated. The combined tables represented 1976 traffic conditions on the Q.E.W. at the Regional boundary.

The original O.D. tables at each station location represent outbound traffic conditions only.

Once the O.D. tables were built for all stations on the external cordon and these tables were verified, the tables were combined to produce one table for the peak hour traffic and one table for the 24 hour A.A.D.T. These tables represent all outbound trips crossing the external cordon.

The two (one directional) tables were then transposed so that they adequately represent two directional trips into, out of and through the Region. The tables were transposed with the use of the ratio of inbound to outbound trips from the vehicle counts for the peak hour and the 24 hour periods.

4.9 VALIDITY CHECKS

O.D. tables on a station by station basis were checked against four sources of information.

The first check consisted of visually examining origin-destination pairs for selected stations and deciding whether that trip should logically pass that station. For example, if it was apparent that as a result of the origin and destination that the trips in that interchange would not logically pass through the station to which it was assigned all trips in the O.D. pair were dropped from the table. In cases were there was any doubt, the O.D. pair was assigned to that station.

The second check consisted of comparing the number of total trips in the O.D. table to the mechanical vehicle counts taken at the station at the time of the survey. Adjustments were made to the total trips in the O.D. table to account for the fact that they are based on the A.A.D.T.'s, not the actual vehicle count information.

The third check consisted of comparing the number of peak hour vehicle trips with the vehicle classification counts taken on the day of the survey. This check was necessary to insure that O.D. tables had a logical mix of passenger vehicles and trucks.

The fourth check consisted of comparing the total O.D. table trips by station with factored Average Annual Daily Traffic estimates. The A.A.D.T.'s were factored by their design hourly volume (D.H.V.) to obtain an estimate of peak hour volumes. This was necessary to ensure that the base year estimates of peak hour travel volumes were consistent with estimates used in other studies.

4.10 TRAVEL FORECASTS

The future external travel demands were calculated utilizing the Fratar factoring technique. A review of the state of the art of traffic modelling showed that this technique was the only one available that could adequately forecast travel patterns based on available data or data that could be easily obtained from standard traffic surveys.

The Fratar factoring technique calculates future travel demands based on existing travel patterns and expected changes in the rate of trip making. The existing travel patterns were established from the survey information in the

form of p.m. peak hour and 24 hour origin-destination tables. The expected changes in the rate of trip making are related to changes in the land use activities (population and employment) at the origin and destination of the trips. The general Fratar equation and the specific equations to calculate the expected rate of change in trip making are shown in Appendix C.

The technique as outlined in Appendix C requires the following input data:

i) base year origin-destination tables by traffic zone

ii) base year population and employment by traffic zones

iii) horizon year population and employment by traffic zone.

The base year origin-destination tables were developed from the 1976 survey data and represent 1976 travel patterns. However, adequate population and employment information was not available for 1976. Previous Provincial and Regional transportation studies had used 1971 as a base year because it was a census year and very reliable land use measures had been established for that year. To develop additional land use data for 1976 would have been too costly and the data would not have been adequately reliable, so it was decided that 1971 would be the base year from which to forecast future travel. The 1971 land use information was readily available from the Toronto Area Regional Model Study (TARMS) and the Hamilton-Wentworth Regional Official Plan studies.

In order to use 1971 as a base year, it was necessary to develop 1971 origin-destination tables. This was accomplished by factoring the 1976 origin-destination tables for each survey station by the ratio of 1971 traffic counts to

1976 traffic counts. The tables as developed are an approximation of 1971. It was felt that any error introduced in the procedure was minimal and definitely less than the error involved in developing 1976 land use data.

The year 2001 was used as the horizon year as it is compatible with the internal model developed for the Region and forecasts of land use were available for that year. Within the Region the 2001 population and employment from the draft Official Plan - Recommended Development Pattern was used.[1] The 2001 population and employment outside the Region is compatible with the TARMS Test 6 data developed by the Ministry of Transportation and Communications. All land use data was easily converted to the desired zonal system.

---

1. A Regional Development Pattern for Hamilton-Wentworth, Regional Planning and Development Department, September, 1977.

5.0 PRESENTATION OF RESULTS

This chapter presents a summary of the findings of the study. The conclusions that can be drawn from the study results are contained in Chapter 6.0. The results of the study have been organized in a manner to display:

- the characteristics of trip makers
- the existing travel patterns and traffic flows, and
- forecasted future travel patterns and traffic flows.

5.1 TRAVEL CHARACTERISTICS

It is important to understand the characteristics of the persons making trips in order to better understand the existing traffic patterns and to predict future changes in those traffic patterns. In order to estimate the potential changes in traffic due to changes in economic conditions, availability of fuel, technological changes or modification of transportation networks, it is necessary to know why trips are made, the orientation of trips, the length of trips, the time trips are made at, etc.

The travel characteristics described in this section have been calculated from the data collected in the 1976 traffic surveys.

5.1.1 VARIATION IN TRAVEL OVER TIME

The volume of traffic varies with the time of year, day of the week and hour of the day. Roads must be designed to adequately accommodate the peaks in this fluctuating demand. The seasonal variations are regularly monitored by the Ministry of Transportation and Communications and are accounted for when calculating the Average Annual Daily Traffic (A.A.D.T.) for any road. Certain Provincial Highways utilized by large volumes of recreational traffic have peak volumes of traffic on weekends, but most roads experience their highest traffic demands as a result of traffic during the week. This study is limited to information gained on a weekday survey and is concerned with regular commuter patterns.

Figure 5.1 is a graph of the variation of hourly vehicle volumes by time of day, as derived from the vehicle classification counts. The graph shows the variation of all external traffic as well as the variation by road type. It shows that Regional Roads are used by a small percentage of external travel and that the majority uses Highway 403 and the Q.E.W.

The shape of the graphs for the different road types are similar showing the most pronounced peak in travel occurring in the afternoon between 4:30 and 5:30 p.m. A similar peak occurs on all facilities to a lesser degree in the morning between 8:00 and 9:00 a.m. There is a small peaking in travel between 12:00 noon and 1:00 o'clock on most facilities, with the exception of Highway 403.

Figure 5.2 is similar to 5.1 but plots the percentage of travel by hour rather than the absolute numbers of vehicles. This figure emphasizes the similarity in peaking conditions in all road types.

FIGURE 5.1

HOURLY VEHICLE VARIATION

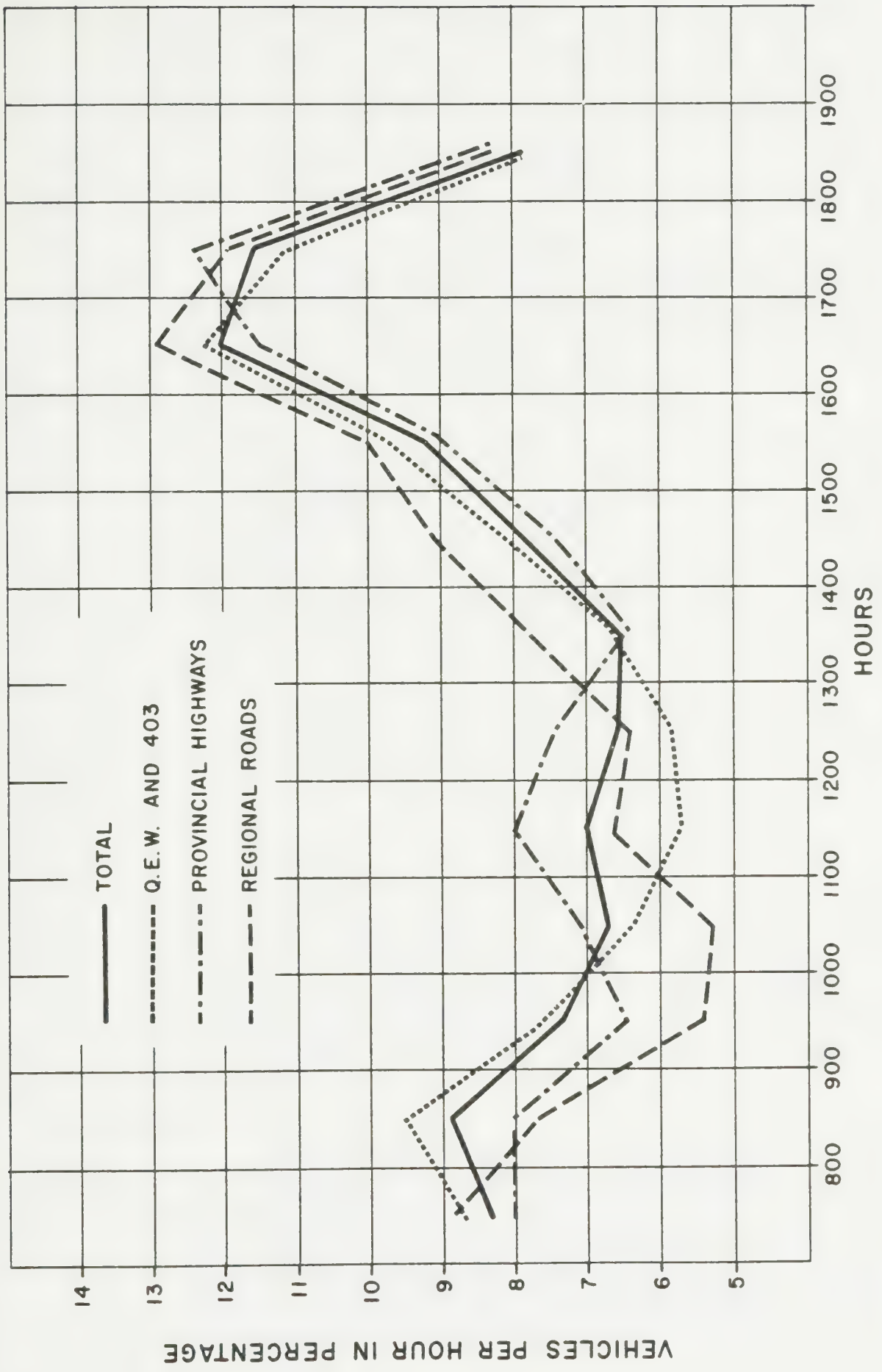


FIGURE 5.2

HOURLY VEHICLE VARIATION AS A PERCENTAGE

5.1.2 TRAVEL BY PURPOSE

All travel has a purpose and all traffic on the road is there for a reason. By better understanding why the travel occurs it is possible to understand existing traffic conditions, find workable solutions to traffic problems and project future changes in traffic patterns.

For the purpose of this survey trip purposes were categorized as work, school, recreation, shopping, personal business and other. Due to limitations in the travel forecasting procedures it was necessary to further amalgamate the trip purposes, to include only work and non-work categories. These two trip purposes could be related to available land use data at the trip ends, and forecasts can be related to changes in land use.

Figures 5.3 and 5.4 are plots of the variation of the two major trip purpose categories over time. A graph has been prepared for each of the major road types.

During the morning and afternoon peaks the majority of travel on all road types is for purposes of work. In the morning peak, the graphs show that up to 90 percent of the traffic on the road is work related. During the afternoon peak there is more traffic on the road system and work related trips account for between 60 and 75 percent of the total travel. Work related travel falls off between the peaks accounting for less than 40 percent of the travel on most roads at midday.

Non-work related travel tends to occur in the non peak period. There is little non-work travel in the morning peak. It increases steadily until it accounts for the majority of travel after 10:00 a.m. The amount of non-work travel is fairly consistent through the midday period with a small peak before noon hour. Non-work travel decreases between 4:00 and 6:00 p.m. and increases sharply again after 6:00 p.m.

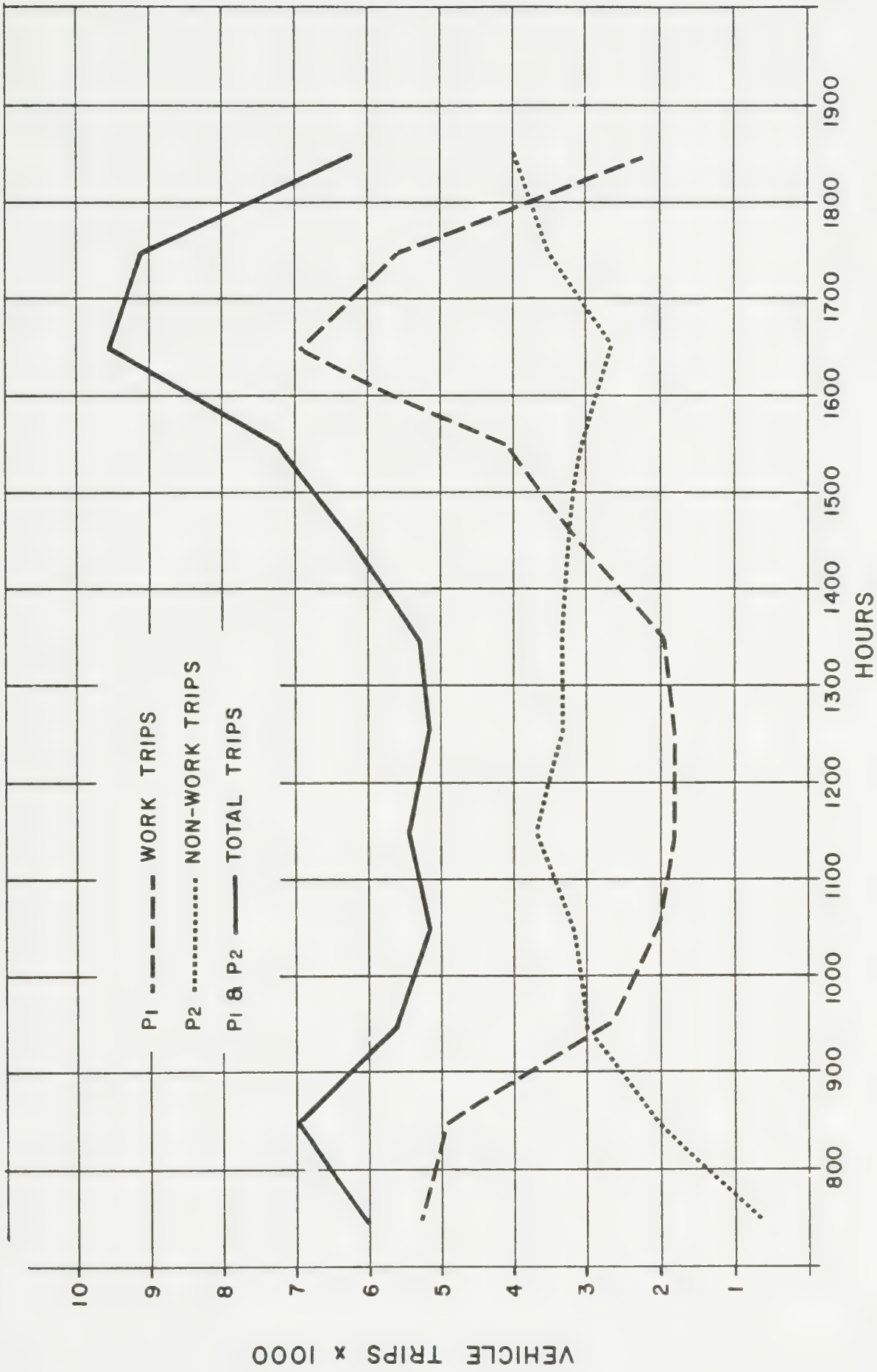


FIGURE 5.3

NORMAL WEEKDAY DISTRIBUTION OF TRAFFIC BY PURPOSE
ON REGIONAL ROADS AND PROVINCIAL HIGHWAYS.

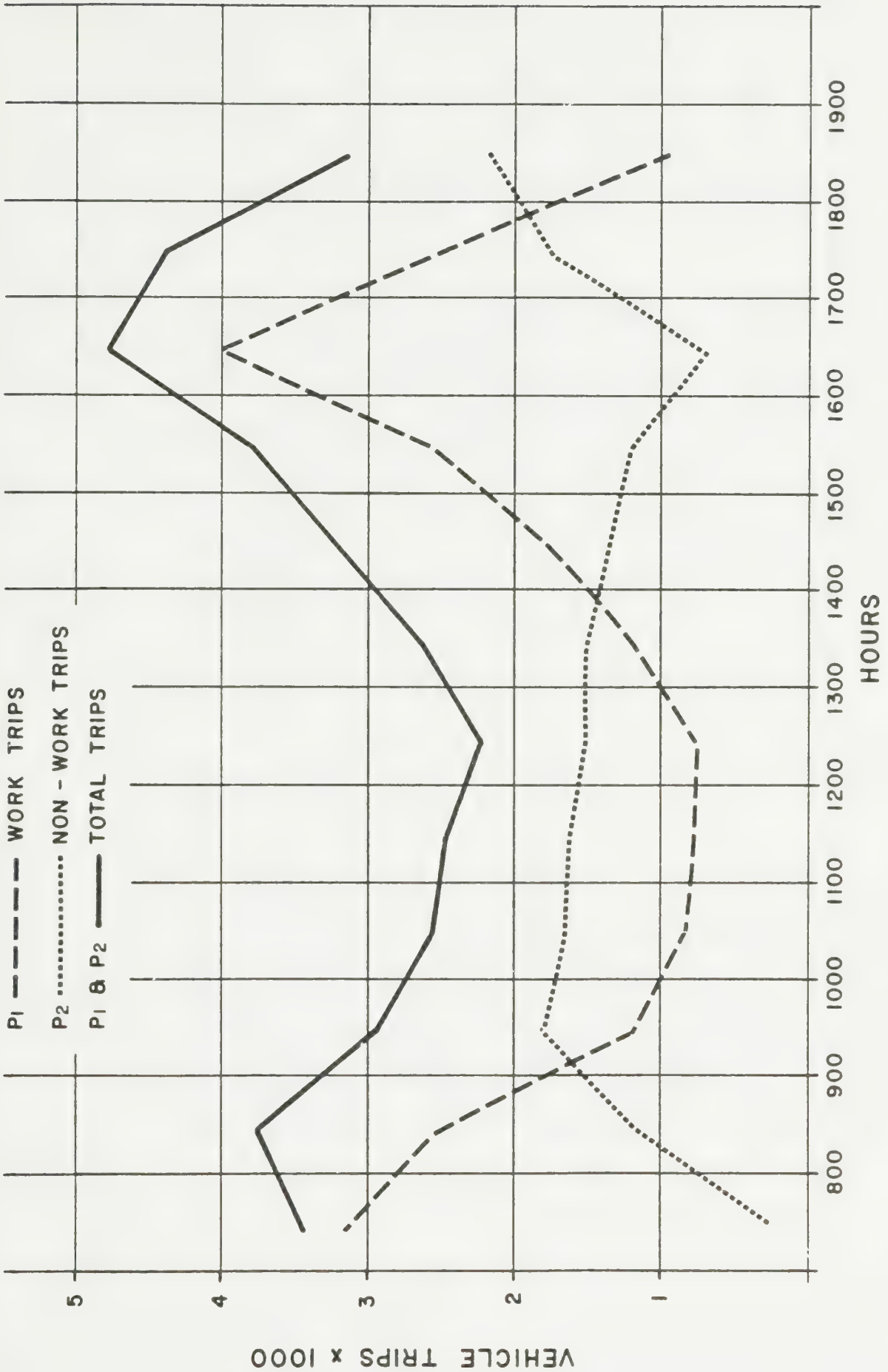


FIGURE 5.4

NORMAL WEEKDAY DISTRIBUTION OF TRAFFIC BY PURPOSE ON HIGHWAY 403 AND Q. E. W.

Over an average weekday, work related travel accounts for 55 percent of the external traffic on all road types.

The graph indicates that for the afternoon peak, projected changes in traffic depend mainly on changes in work trips. An analysis of work trip ends indicates that, in the afternoon peak, the trip origins are related to industrial and commercial development and the trip attractions are related to residential development. Employment and population projections were used as indicators of these types of development. A similar analysis of trips over the twenty-four hour period showed that changes in both trip production and trip attractions can be related to a combination of changes in population and employment at the two trip ends. The equations as shown in Appendix E were developed based on this information.

5.1.3 VEHICLE OCCUPANCY RATES

Theoretically, the volume of traffic on the road system varies inversely with the average number of people riding in each automobile.

The existing car occupancy rates vary by trip purpose, by time of day and by road type. Figures 5.5 and 5.6 show these variations. The car occupancy rates remain relatively constant throughout the day with the occupancy for work trips averaging around 1.3 persons per auto and for non-work averaging around 2.0 persons per auto. Because of the large number of work related trips in the peak hours the overall car occupancy on the road system tends to decrease at these times. Table 5.1 shows the variation in car occupancy between the peak and 12 hour periods.

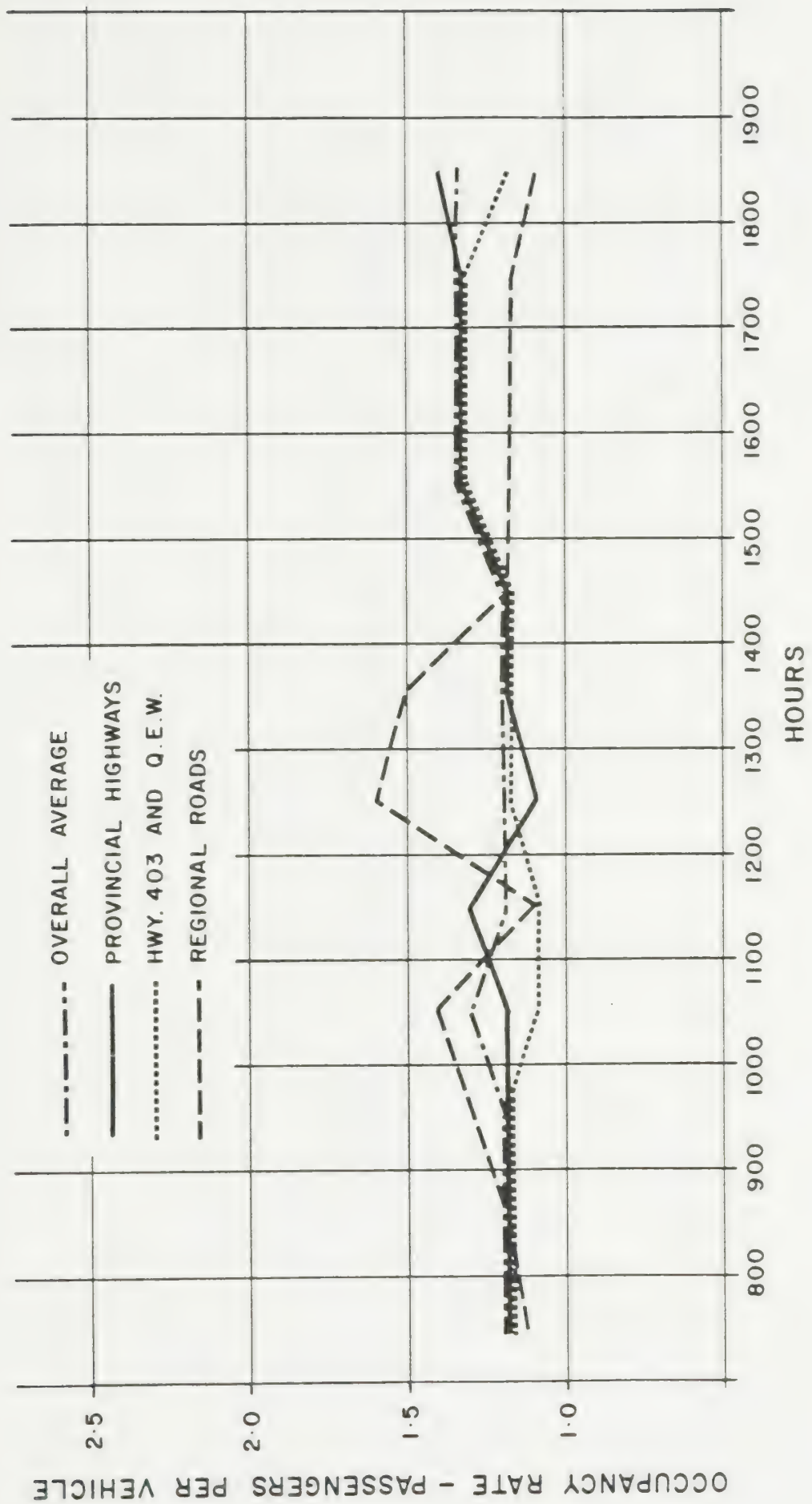


FIGURE 5.5

VARIATION IN HOURLY VEHICLE OCCUPANCY RATES

FOR NORMAL WEEKDAY WORK TRIPS

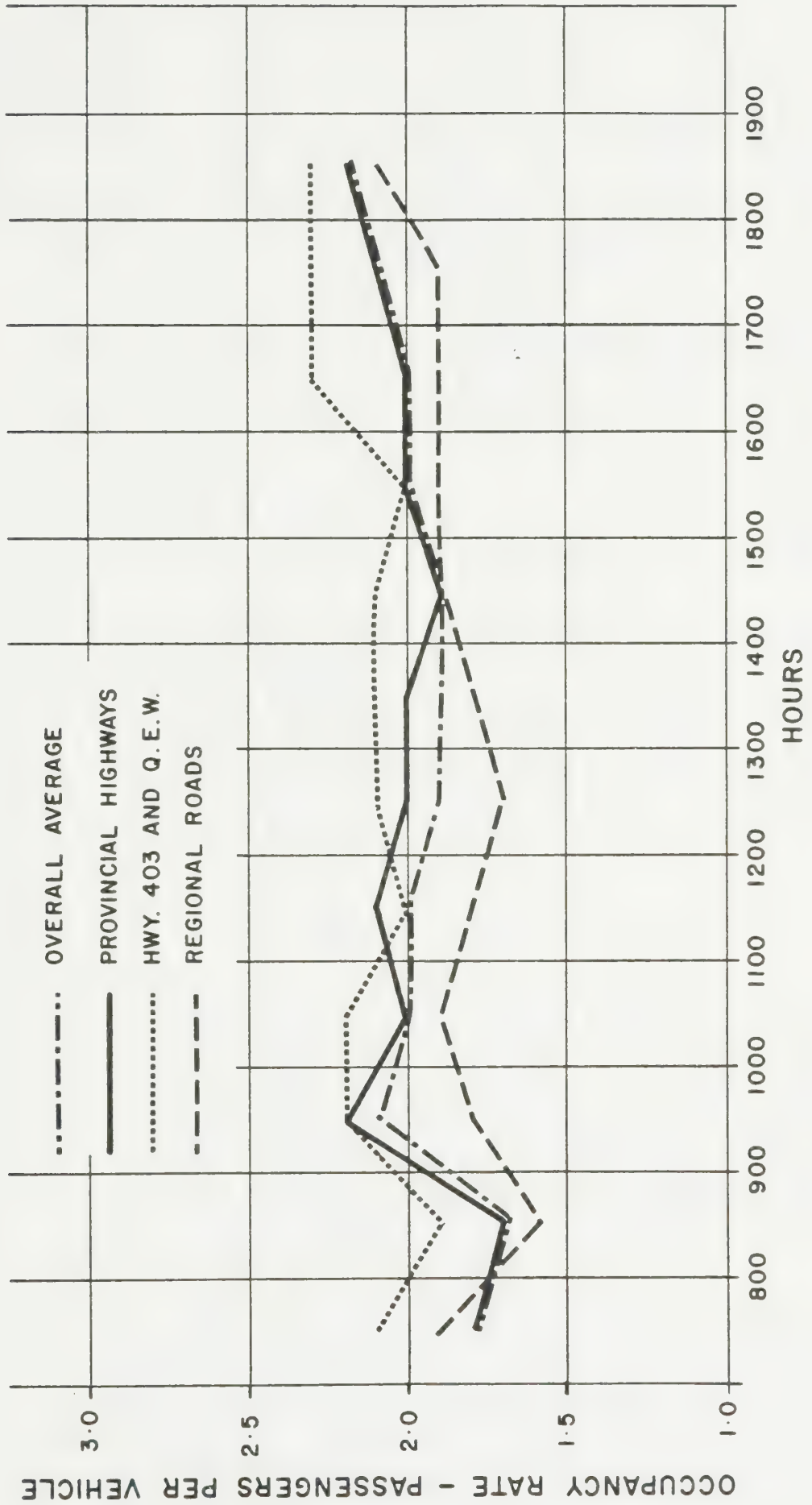


FIGURE 5.6

VARIATION IN HOURLY VEHICLE OCCUPANCY RATES

FOR NORMAL WEEKDAY NON-WORK TRIPS

TABLE 5.1

CAR OCCUPANCY SUMMARY

PURPOSE	AVERAGE PERSONS PER AUTO	
	12 HOUR	P.M. PEAK HOUR
WORK	1.24	1.27
NON-WORK	2.00	2.01
ALL	1.57	1.45

Figure 5.6 shows that the Q.E.W. and Highway 403 tend to have a higher car occupancy rate than the other facilities for non-work trips and Regional Roads have a lower car occupancy rate. It is reasonable to assume that this is because the average trip on the controlled access highways is longer than the mean trip length and that those on Regional Roads are shorter than the mean.

5.1.4 TRIP DIRECTION

At most stations, origin-destination information was collected for only those trips leaving the Region. It was assumed that the trips entering the Region would have basically the same travel characteristics. The ratio of trips by direction was calculated at each station in order to estimate the impact of traffic into the Region. Since the afternoon peak hour was used in traffic simulation and Hamilton-Wentworth is a major employment center, trips in the outbound direction are predominant on most roads.

Table 5.2 shows the directional splits as calculated for the p.m. peak hour from the 1976 survey data for all survey stations. The majority of stations show that 60 percent of the traffic is in an outbound direction. Local influences on some of the roads account for the majority of travel being inbound in the peak or for an even split in trip direction.

TABLE 5.2

DIRECTIONAL SPLITS

(PEAK PERIOD)

LOCATION	STA.	INBOUND TRAFFIC	OUTBOUND TRAFFIC	(IN/OUT) DIRECTION SPLIT
Reg. Rd. 25	4	291	175	60/40
Reg. Rd. 11	5	243	332	40/60
Reg. Rd. 22	7	366	709	30/70
Reg. Rd. 122	10	359	223	60/40
Reg. Rd. 17	13	92	116	40/60
Reg. Rd. 18	15	52	25	60/40
Reg. Rd. 36	16	62	45	60/40
Reg. Rd. 7	17	22	30	40/60
Reg. Rd. 9	19	264	119	70/30
Beach	28	1,975	2,863	40/60
Q.E.W.	1	1,109	1,862	40/60
403	2			
Q.E.W.	25	7,773	5,974	60/40
Hwy. 8	3	1,605	2,162	40/60
Hwy. 20	6	1,566	1,605	40/60
Hwy. 56	8	85	272	30/70
Hwy. 6	9	664	981	40/60
Hwy. 2	12	3,432	3,560	50/50
Hwy. 97	14	36	48	40/60
Hwy. 5	18	493	360	60/40
Hwy. 99	31	478	363	60/40
Hwy. 5	32	516	440	50/50
Hwy. 6	33	2,302	2,520	50/50
Hwy. 8	35	279	229	50/50
Plains	20	3,718	4,322	40/60

The average directional split for all stations show 60 percent of the traffic being outbound in the p.m. peak hour. This factor was used for traffic simulation purposes, when transposing the peak hour O.D. table.

5.2 BASE YEAR TRAVEL PATTERNS

The information from the traffic and travel characteristics surveys has been summarized in a number of different forms. The origin-destination (O.D.) tables developed from the survey are the base for the analysis of the existing external traffic and the forecasts of future external O.D. tables. The O.D. table for the base year peak hour is contained in Appendix D.

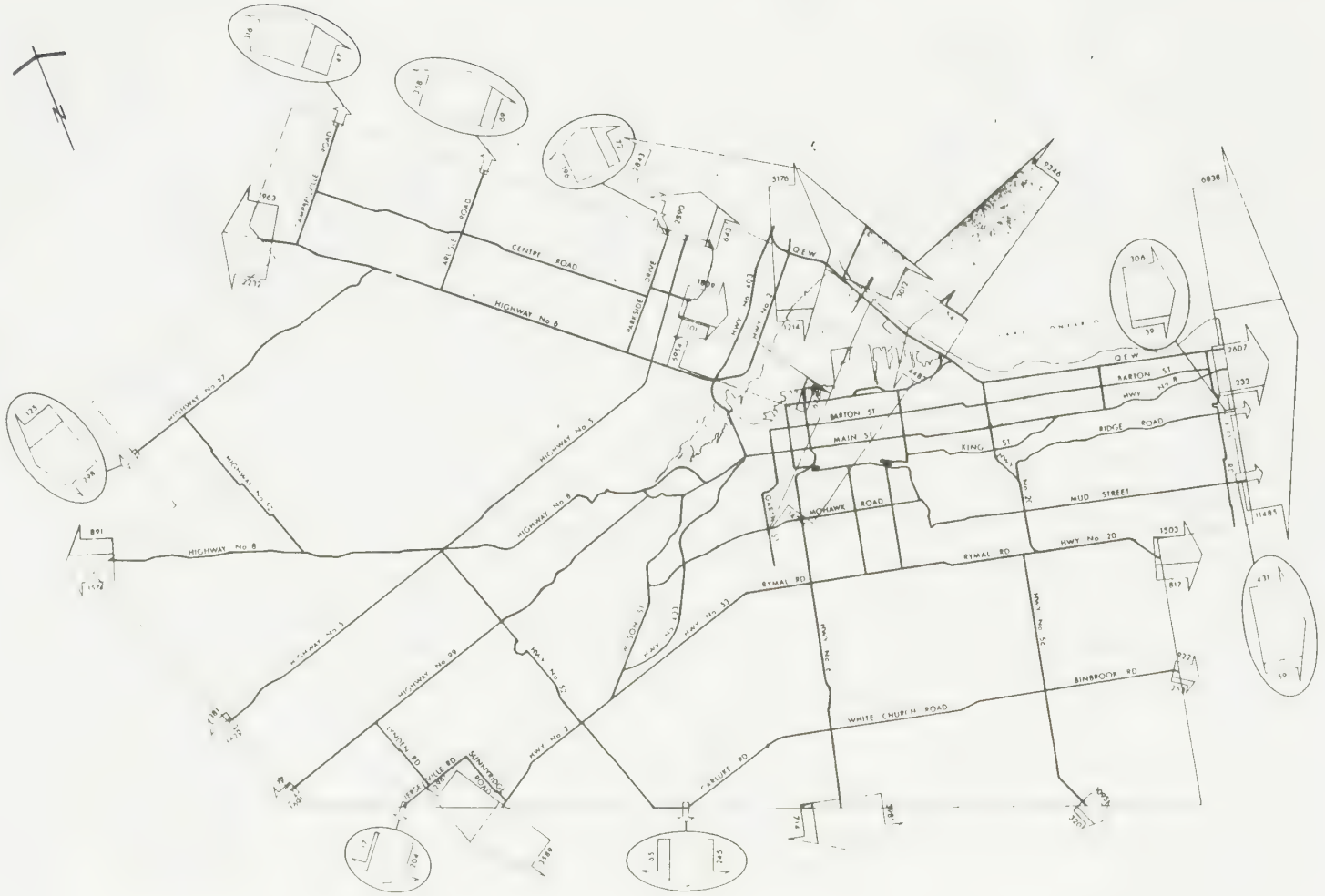
The information from the O.D. tables has been further summarized to show external traffic conditions:

- by station
- by destination outside the Region
- by origin inside the Region
- for through traffic, and
- on the internal road system.

5.2.1 TRAFFIC BY SURVEY STATION

Figures 5.7 and 5.8 show the 24 hour and p.m. peak hour traffic volumes leaving the Region at each station. The traffic has been divided into destined and through traffic.

Fig. 5.7



LEGEND

DIRECTION OF TRAVEL

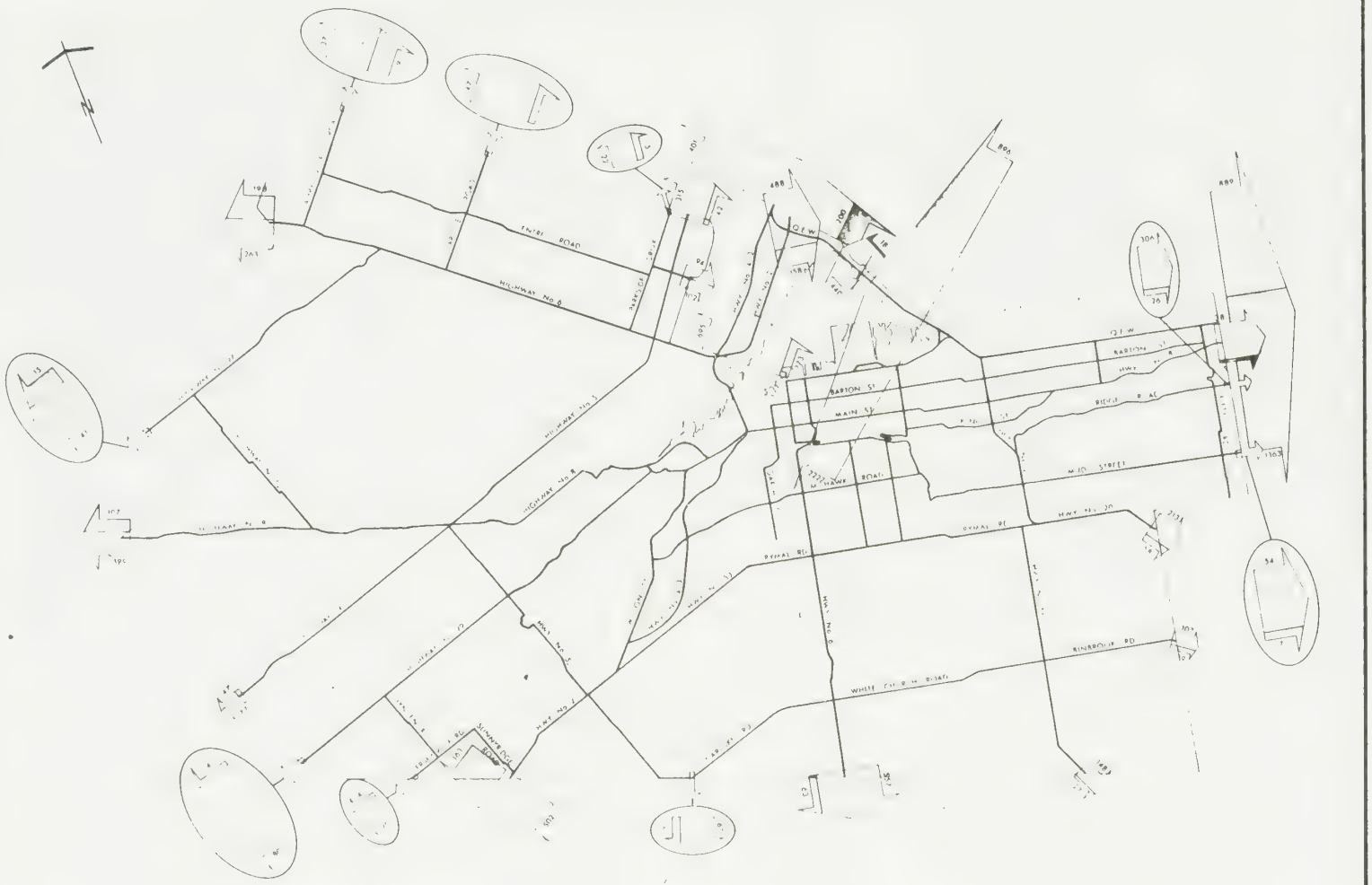
DESTINED TRAFFIC

THROUGH TRAFFIC

24 HOUR EXTERNAL TRAFFIC BY STATION

Planning & Development Department
Hamilton Wentworth Region

Fig. 5.8



LEGEND

DIRECTION OF TRAVEL

DESTINED TRAFFIC

THROUGH TRAFFIC

PEAK HOUR EXTERNAL TRAFFIC BY STATION

Planning & Development Department
Hamilton Wentworth Region

The Q.E.W. and Highway 403 are used by most traffic leaving the Region, carrying approximately 63,500 vehicles daily (one direction) or 56 percent of the total outbound traffic crossing the external cordon. The other Provincial Highways carry approximately 37,000 vehicles or 33 percent of the outbound traffic. Regional Roads are used by only 11 percent of the outbound traffic crossing the external cordon or 12,500 vehicles over a 24 hour period.

The tendency for external trip makers to use main Provincial Highways is even more prevalent when only through traffic is examined. Over a 24 hour period through traffic accounts for 20 percent of all externally oriented traffic on Regional Roads, 28 percent on the Q.E.W. and Highway 403 and 37 percent on other Provincial Highways. During the p.m. peak hour these percentages change to 20, 26 and 33 respectively.

Traffic distribution by facility type in the peak hour is similar to the distribution over the 24 hour period.

5.2.2 EXTERNAL TRIP ENDS

Figures 5.9 and 5.10 show the destination of external travel outside the Hamilton-Wentworth Region. The travel is divided into through and destined traffic. The diagrams show that the majority of traffic is destined to areas immediately adjacent to the Region.

Over a twenty-four hour period, 42 percent of all traffic crossing the external cordon has a trip end in Burlington. Of the destined trips with one end in Hamilton, 50 percent have the other trip end in Burlington. Of the other surrounding areas Brant County accounts for 7 percent of the trips crossing the external cordon in a 24 hour period, Central Lake Erie area 6 percent, Waterloo 5 percent and Oakville 5 percent. Metro Toronto because of its size has a significant impact on traffic, accounting for 9 percent of the traffic crossing the external cordon. Approximately half of trips terminating in Toronto travel through Hamilton-Wentworth.

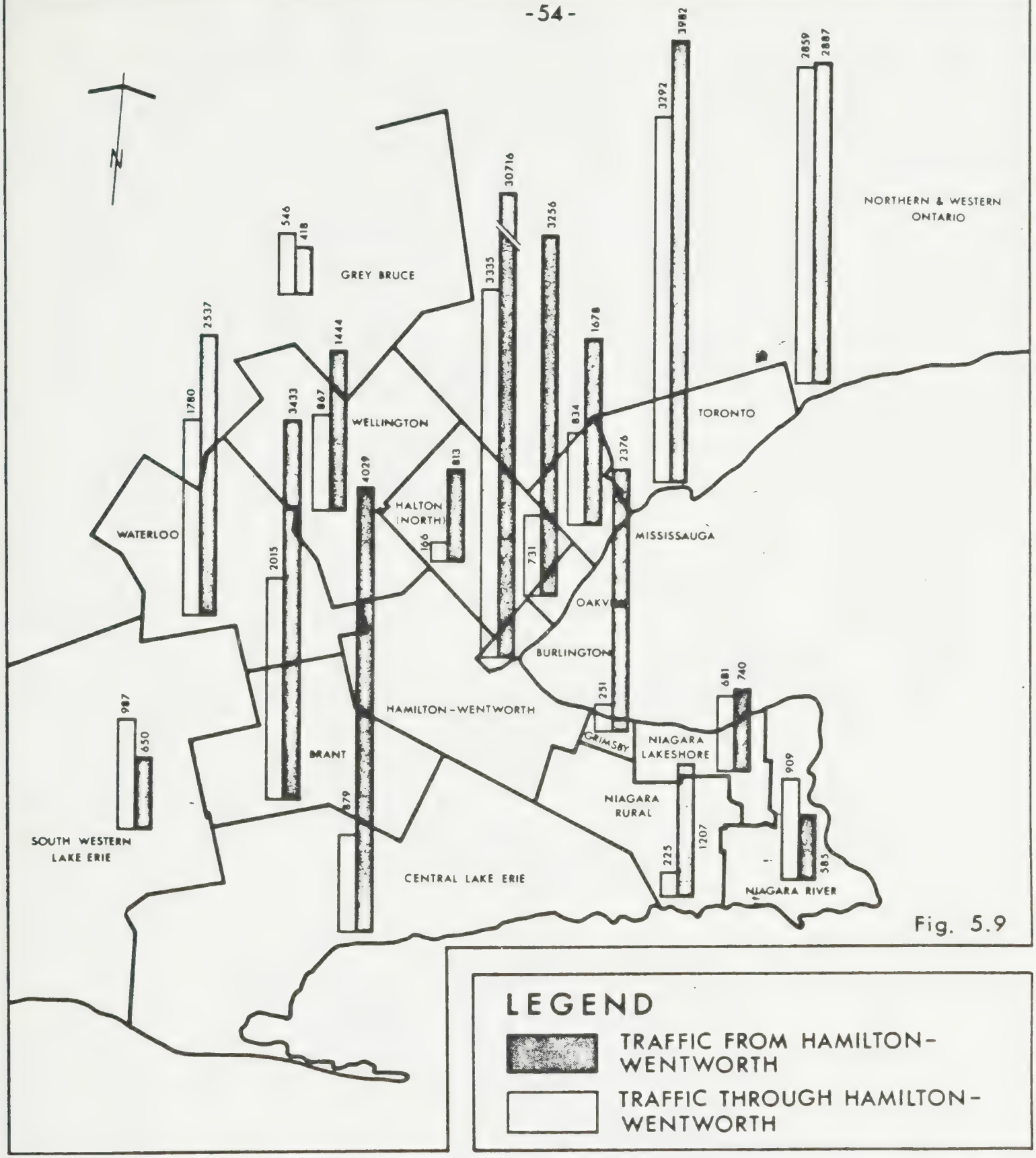


Fig. 5.9

LEGEND

TRAFFIC FROM HAMILTON-WENTWORTH

TRAFFIC THROUGH HAMILTON-WENTWORTH

24 HOUR DESTINATIONS OF EXTERNAL TRAFFIC

Planning & Development Department
Hamilton - Wentworth Region

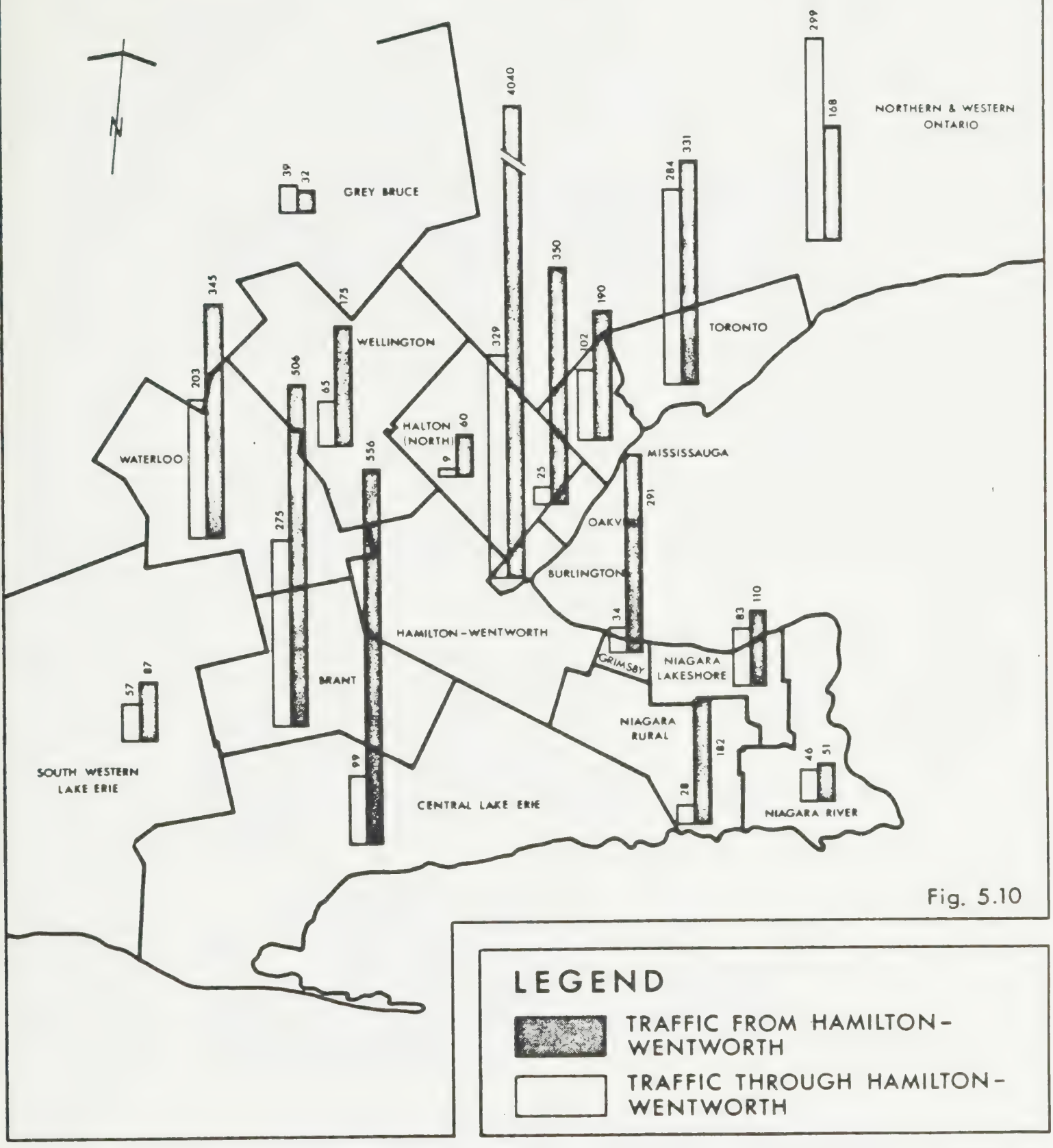


Fig. 5.10

LEGEND

- TRAFFIC FROM HAMILTON-WENTWORTH
- TRAFFIC THROUGH HAMILTON-WENTWORTH

PEAK HOUR DESTINATIONS OF EXTERNAL TRAFFIC

Planning & Development Department
Hamilton - Wentworth Region

In the peak hour, destined trips are more prevalent with a slightly higher percentage of trips terminating in areas immediately adjacent to the Region. In this time period Burlington accounts for 54 percent of the Hamilton-Wentworth destined trips and 46 percent of all trips crossing the screenline.

5.2.3 INTERNAL TRIP ENDS

Tables 5.3 and 5.4 show the internal origin of all traffic crossing the Regional boundary in the outbound direction. The data is for a 24 hour and the p.m. peak hour periods respectively. The display of data is disaggregated by the screenlines shown in Figure 5.11.

In the 24 hour period only 26 percent of the traffic crossing the Regional boundary was through traffic. That drops to 22 percent in p.m. peak hour conditions. Through traffic accounts for a significant percentage of the total traffic on screenlines 3 and 4 and on the Q.E.W. In the peak hour, through traffic accounts for 22 percent of all external traffic. The percentage of through traffic is less in the peak hour on all screenlines except screenline 6.

Of the external destined traffic the majority has a trip end in the City of Hamilton. Over 24 hours 52 percent of the trips crossing the screenline had a trip end in Hamilton. In the peak hour this increases to 61 percent. External destined traffic to and from Hamilton dominates screenlines 1, 2, 5 and 6 as well as Highway 403 and the Q.E.W. in the peak hour as well as the 24 hour period.

The majority of traffic crossing screenline 5, both in peak hour and 24 hour periods, is destined traffic from Flamborough. This municipality is the second largest influence on external traffic after Hamilton.

TABLE 5.3

INTERNAL TRIP ENDS (24 HOUR PERIOD)

SCREENLINE	ORIGINS						TOTAL DESTINED	TOTAL THROUGH	COMBINED TOTAL
	FLAMBOROUGH	DUNDAS	ANCASTER	GLANBROOK	STONEY CREEK	HAMILTON			
1. AADT	69	80	92	196	1,831	5,942	8,210	3,305	11,515
%	0.6	0.7	0.8	1.7	15.9	51.6	71.3	28.7	100
2. AADT	51	83	225	494	302	4,122	5,277	1,143	6,420
%	0.8	1.3	3.5	7.7	4.7	64.2	82.2	17.8	100
3. AADT	1,358	410	760	68	154	2,725	5,475	3,067	8,542
%	15.9	4.8	8.9	0.8	1.8	31.9	64.1	35.9	100
4. AADT	1,551	269	114	14	92	2,104	4,144	2,939	7,083
%	21.9	3.8	1.6	0.2	1.3	29.7	58.5	41.5	100
5. AADT	2,805	136	38	9	14	690	3,692	999	4,691
%	59.8	2.9	0.8	0.2	0.3	14.7	78.7	21.3	100
6. AADT*	2,665	510	112	80	766	11,026	15,159	798	15,957
%	16.7	3.2	0.7	0.5	4.8	69.1	95.0	5.0	100
Hwy. 403 AADT	912	1,401	1,201	111	67	14,326	18,018	4,227	22,245
%	4.1	6.3	5.4	0.5	0.3	64.4	81.0	19.0	100
Q.E.W. AADT	24	0	0	94	3,123	11,073	14,314	9,346	23,660
%	0.1	0	0	0.4	13.2	46.8	60.5	39.5	100
TOTAL	9,435	2,889	2,542	1,066	6,349	52,008	74,289	25,824	100,113
	9.4%	2.9%	2.5%	1.1%	6.3%	52.0%	14.2%	25.8%	100%

* excluding Hwy. 403 and Q.E.W.

TABLE 5.4

INTERNAL TRIP ENDS (PEAK PERIOD)

SCREENLINE	ORIGINS: FLAMBOROUGH	DUNDAS	ANCASTER	GLANBROOK	STONEY CREEK	HAMILTON	TOTAL DESTINED	TOTAL THROUGH	COMBINED TOTALS
1. DHV	4	9	9	12	178	767	979	270	1,249
%	0.3	0.7	0.7	1.0	14.3	61.4	78.4	21.6	100
2. DHV	5	9	38	44	37	596	729	102	831
%	0.6	1.1	4.6	5.3	4.4	71.7	87.7	12.3	100
3. DHV	84	61	67	5	18	398	633	337	970
%	8.7	6.3	6.9	0.5	1.9	41.0	65.3	34.7	100
4. DHV	156	29	9	2	6	302	504	319	823
%	18.9	3.5	1.1	0.3	0.7	36.7	61.2	38.8	100
5. DHV	255	9	0	0	3	126	393	105	498
%	51.2	1.9	0	0	0.6	25.3	79.0	21.0	100
6. DVH*	119	32	7	3	108	1,228	1,497	114	1,611
%	7.4	2.0	0.4	0.2	6.7	76.2	92.9	7.1	100
Hwy. 403 DHV	76	76	43	7	7	1,681	1,890	357	2,247
%	3.4	3.4	1.9	0.3	0.3	74.8	84.1	15.9	100
Q.E.W. DHV	6	0	0	6	431	1,784	2,227	896	3,123
%	0.2	0	0	0.2	13.8	57.1	71.3	28.7	100
TOTAL	705	225	173	79	788	6,882	8,852	2,500	11,352
	6.2%	2.0%	1.5%	0.7%	7.0%	60.6%	78.0%	22.0%	100

* excluding Hwy. 403 and Q.E.W.

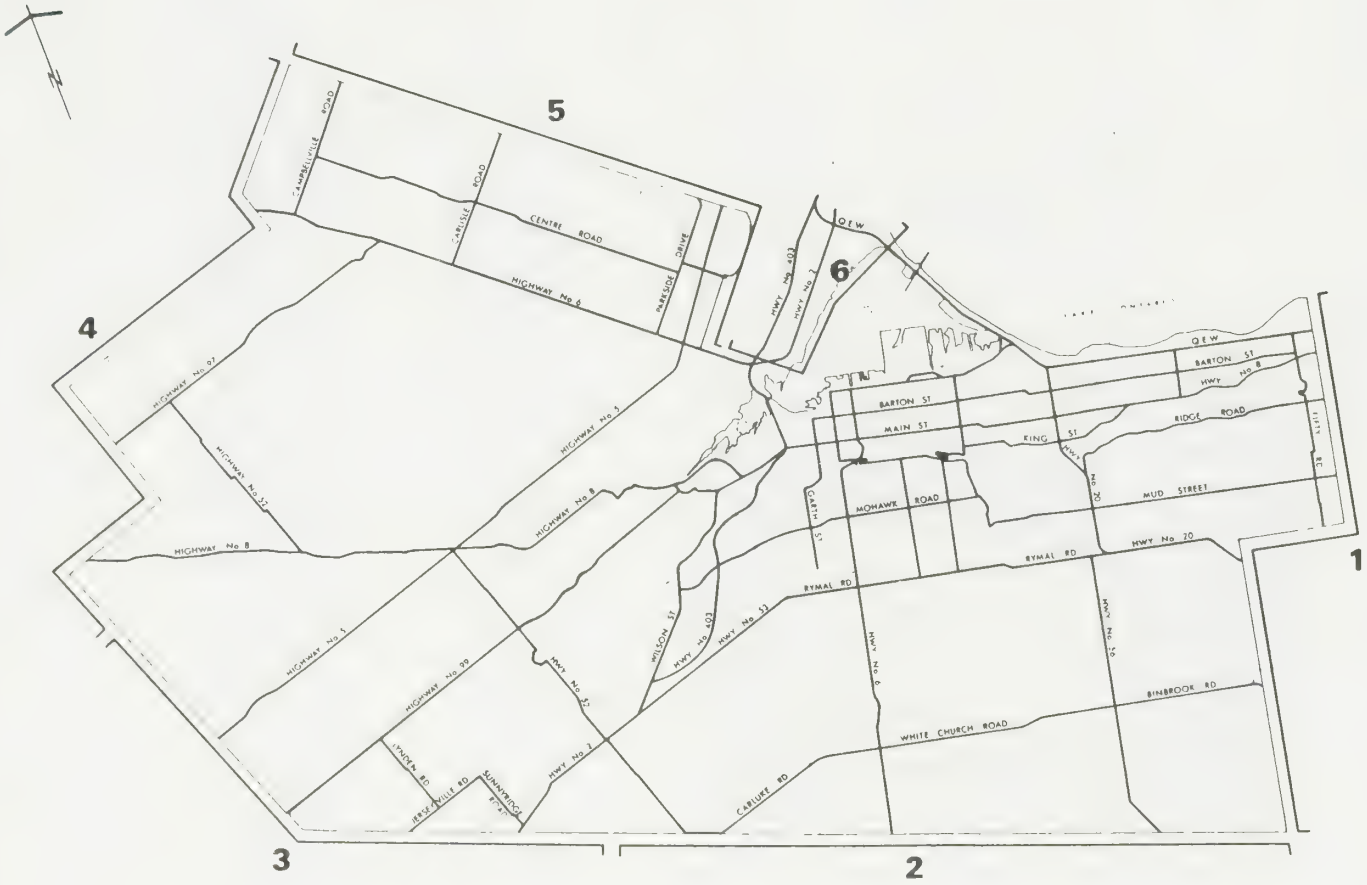


Fig. 5.11

LEGEND

1 TRAFFIC SCREENLINE

TRAFFIC SCREENLINES

Nov. 1978

Planning & Development Department
Hamilton-Wentworth Region

Dundas, Ancaster and Glanbrook have a minor effect on external traffic at present with all three municipalities accounting for less than 7 percent of external traffic over 24 hours and 4 percent in the peak hour.

A significant volume of traffic crossing screenline 1 and travelling on the Q.E.W. is destined to Stoney Creek. Very little traffic crossing the other screenlines originates or terminates in Stoney Creek.

5.2.4 THROUGH TRAFFIC

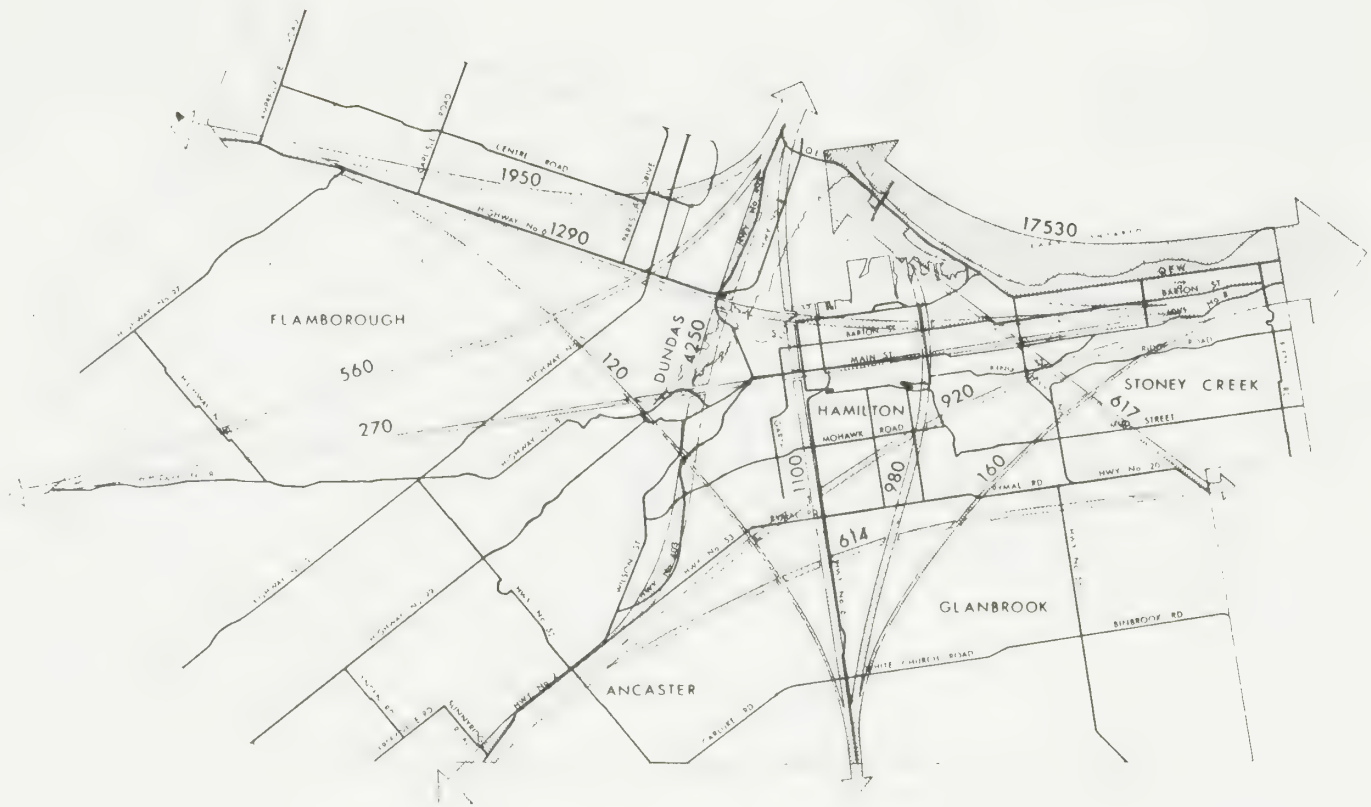
Figures 5.12 and 5.13 depict the flow of traffic that passes through but has neither trip end in the Region of Hamilton-Wentworth. Each band width represents the volume of traffic that flows between the two stations at either end of the band. Traffic volumes of less than 100 vehicles are not depicted for the 24 hour period and traffic volumes of less than 30 vehicles are not depicted for the peak hour.

Through traffic volumes for the 24 hour period are balanced with equal volumes of traffic in either direction. However as Figure 5.13 indicates, during the peak hour the directional splits vary, with some station interchanges having up to a 70/30 directional split.

The majority (57 percent) of the 24 hour through traffic in the Region is on the Q.E.W. The second largest flow of through traffic uses Highway 2 west and Highway 403.

There are approximately 2,000 vehicles travelling through Hamilton-Wentworth between Haldimand-Norfolk and Burlington and points east. Of these approximately one half travel via the Q.E.W. Skyway and one half via Highway 403.

Fig. 5.12



LEGEND

17530

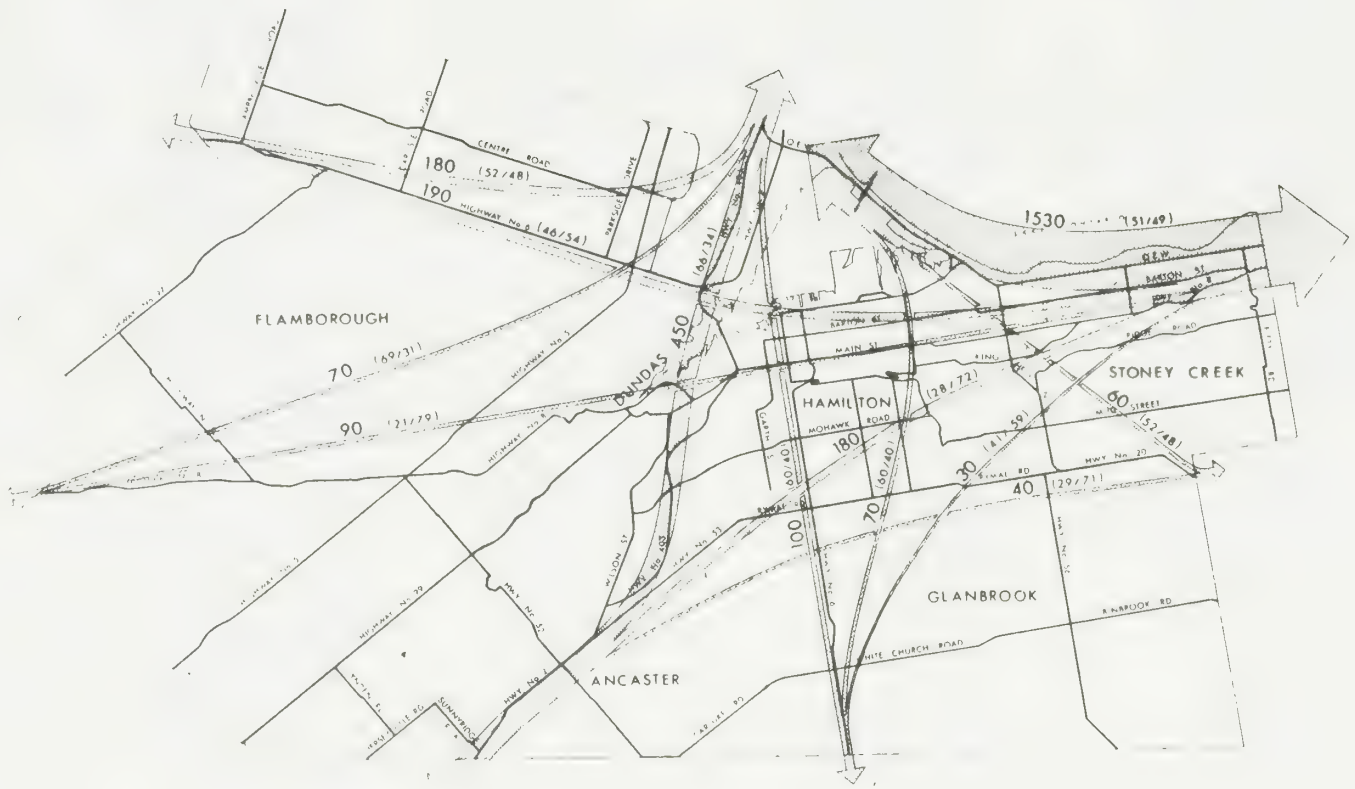
24 Hour Two Way Through Vehicles

(50/50 Directional Split For All Interchanges)

TWO WAY 24 HOUR THROUGH TRAFFIC INTERCHANGE

Planning & Development Department
Hamilton - Wentworth Region

Fig. 5.13



LEGEND

Peak Hour Through Vehicles

% West Bound Vehicles

% East Bound Vehicles

1530 (51/49)

Peak Hour Through Vehicles

TWO WAY PEAK HOUR THROUGH TRAFFIC INTERCHANGE

Planning & Development Department
Hamilton - Wentworth Region

The majority of through traffic on Highway 6 north is oriented toward Burlington and points east. A slightly smaller proportion is oriented toward Niagara.

In the peak hour the Q.E.W. still is used by 51 percent of the traffic travelling through the Region, with Highway 403 accounting for an additional 16 percent. The traffic between the Haldimand-Norfolk area and the Toronto area is again equally divided between Highway 403 and the Skyway.

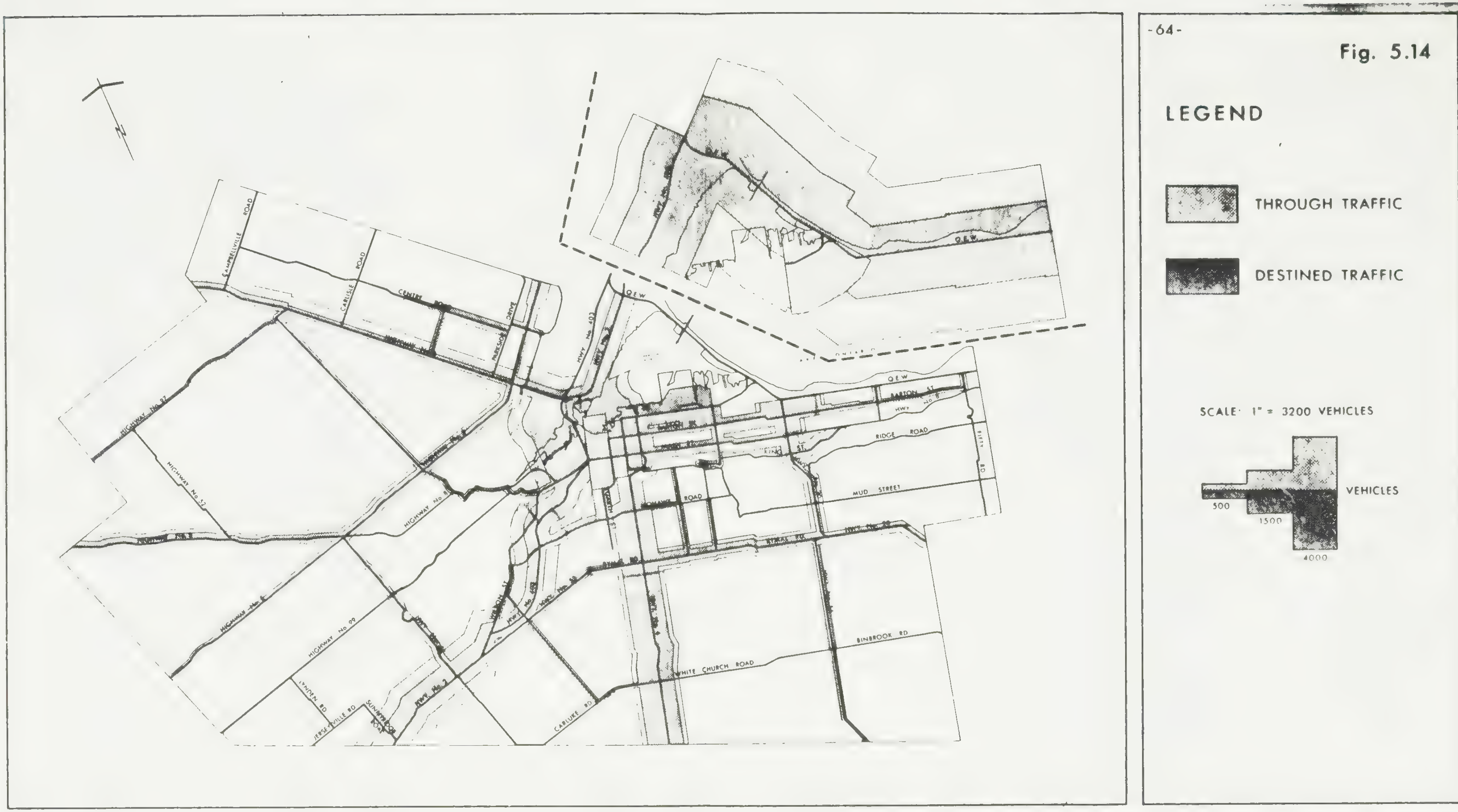
5.2.5 TRAFFIC ROUTING

The O.D. tables developed from the survey data were assigned by means of comuter simulation to the road network in the Hamilton-Wentworth Region. The computer assignment shows approximately what routes the external traffic takes in the Region and how much external traffic there is on specific roads in the Region.

Figure 5.14 is the assigned p.m. peak hour external traffic representing 1976 conditions. The traffic assignment shows both the through and the destined traffic. Because of the necessary simplification of the road network in the computer simulation process none of the minor roads are included. This could account for a slight over simulation of traffic on major road links.

The traffic assignment shows that most through traffic uses the basic Provincial Highway system. The majority of through traffic is on the Q.E.W. and Highway 403. Some through traffic is on Highway 8 west, Highway 6 north and south, Highway 53, Highway 20 and Highway 5. Through traffic has no measurable impact on local streets and Regional Roads.

Fig. 5.14



1976 PEAK HOUR TRAFFIC ASSIGNMENT

Planning & Development Department
Hamilton - Wentworth Region

External destined traffic effects both Provincial Highways and major Regional Roads. The Regional Roads effected most by external destined traffic include: Burlington Street, King Street, Main Street, Upper James, Wellington and Victoria. The volumes of through and destined traffic on other Regional Roads are not large enough to have any definite effect on the operation of the roads.

5.2.6 TRUCK TRAFFIC

Table 5.5 shows the percentage of heavy truck traffic by station for both the 12 hour period and the p.m. peak hour. Due to limitations in time and in the modelling procedures it was decided that truck traffic would be treated as a percentage add-on factor rather than modelling it separately.

The average percentage of trucks is 12 percent over 12 hours and 7 percent during the p.m. peak hour. For purposes of measuring the overall effect of external truck traffic on the road system the average percentage trucks is utilized. However, because the percentage varies widely by station it is recommended that more detailed analysis of truck movements be done when studying specific road links.

5.2.7 VALIDATION

Table 5.6 is a comparison of the 1976 observed and simulated external traffic demands in the peak hour by major road crossing and by screenline.* The comparison was made to ensure the accuracy of the computer assignment in representing road conditions in 1976. The observed 1976 volumes are taken from the Ministry of Transportation and Communications counts.

---

* The screenlines were used to group data at points of interest. Screenline locations are shown in Figure 5.13.

TABLE 5.5

PERCENT HEAVY TRUCKS BY STATION

STATION	12 HOUR TRUCKS	% TRUCKS (OF 12 HOUR)	PEAK HOUR TRUCKS	% TRUCKS (OF PEAK HOUR)
1	2,215	16.4	133	7.1
2	2,335	12.6	171	7.0
3	125	5.9	12	3.9
4	9	21.9	-	-
5	80	18.2	3	4.4
6	208	11.2	23	9.5
7	64	7.6	5	3.0
8	158	9.9	13	4.9
9	440	10.9	35	6.1
10	19	8.7	6	11.8
12	1,090	18.6	95	15.0
13	15	8.6	0	0
14	18	5.6	2	5.9
15	25	7.2	2	5.7
16	45	12.6	4	8.9
17	26	11.7	1	3.4
18	287	9.0	19	5.3
19	46	3.4	4	3.1
20	509	8.0	50	4.7
21	97	7.8	8	3.4
22	63	5.9	6	2.7
24	2,092	14.8	217	16.1
25	3,220	15.5	295	11.0
26	751	15.0	42	7.8
28	158	4.1	11	1.7
29	139	17.6	12	8.6
30	33	7.5	2	2.1
31	47	8.3	3	5.9
32	112	19.8	10	12.0
33	696	20.1	45	10.6
35	250	12.0	23	8.2
TOTAL				

TABLE 5.6

1976 OBSERVED VS. SIMULATED EXTERNAL TRAFFIC

LOCATION SCREENLINES & ROADWAYS	SIMULATED TRAFFIC AUTO	SIMULATED TRAFFIC WITH TRUCKS	OBSERVED WITH TRUCKS	% VARIATION (SIM. VS. OBS.)
1. East Regional Boundary (To Niagara)				
Q.E.W., King St., Ridge Rd.	3,010	3,240		
Hwy. 20, Binbrook Road	190	210		
TOTAL	3,200	3,450	3,040	+13
2. South Regional Boundary (To Haldimand-Norfold)				
Hwy. 56	80	80		
Hwy. 6, Brant Co. Rd. 122	880	940		
TOTAL	960	1,020	1,120	-9
3. West Regional Boundary (To Brantford, South-Western Ontario)				
Hwy. 2, Jerseyville Road	1,060	1,250		
Hwy. 99, Hwy. 5	60	70		
TOTAL	1,120	1,320	1,210	+9
4. NorthWest Regional Boundary (To Kitchener-Waterloo, Guelph)				
Hwy. 8	340	370		
Hwy. 97	50	50		
Hwy. 6	520	580		
TOTAL	910	1,000	960	+4
5. North Burlington Boundary (To North Burlington)				
Campbellville, Carlisle, Parkside	80	80		
Hwy. 5	450	470		
Mill Street	160	180		
TOTAL	690	730	800	-9
5. East Regional Boundary (To Toronto)				
Hwy. 403	2,380	2,560		
Plains Road	440	460		
Q.E.W., Beach Boulevard	3,230	3,630		
TOTAL	6,050	6,650	6,740	-2
TOTAL - ALL SCREENLINES	12,930	14,170	13,930	+2

The comparison shows some variation between the observed and the simulated. The simulation figures tend to be higher than the observed suggesting an oversimulation except at the eastern Regional boundary. It was felt that the discrepancy was not great enough to warrant adjustment of the computer simulation.

5.3 HORIZON YEAR TRAVEL PATTERNS

The origin-destination table developed from the 1976 survey data was the base by which the traffic conditions in the year 2001 were projected. The 2001 O.D. table is contained in Appendix D.

The forecasted external traffic has been analysed to show:

- the growth in travel
- traffic growth by trip generator
- traffic growth by screenline, and
- the projected traffic routing.

5.3.1 GROWTH IN EXTERNAL TRAVEL

The overall results of the forecasted traffic growth are shown in Table 5.7.

TABLE 5.7

FORECASTED GROWTH IN EXTERNAL TRAFFIC

DESCRIPTION	1976	2001	25 YR. GROWTH FACTOR	YEARLY GROWTH RATE
EXTERNAL (Hamilton-Wentworth - Burlington)	6511	14824	228%	3.4%
EXTERNAL (Other)	12407	21384	172%	2.2%
EXTERNAL (Total)	18918	36208	191%	2.6%

The table differentiates trips between Hamilton-Wentworth and Burlington and other external trips. The Burlington based trips have a large impact on travel in Hamilton-Wentworth, accounting for over one third of all external trips. The table shows that the Burlington based external trips are forecasted to increase at a rate of 50 percent greater than other external trips.

As a means of checking the projected growth in external traffic a review was done of the past traffic growth. The Ministry of Transportation and Communications annual count data collected for major roads was used for this check.* The A.A.D.T.'s for these roads were compared for growth between 1971 and 1976. The comparison showed that traffic increased by 127 percent or 5 percent per year. The projected growth to the year 2001 is approximately one half the yearly growth rate that occurred between 1971 and 1976. This can be accounted for by the slower growth rate projected for development in the immediate area.

---

* 1977 Traffic Volumes, Ministry of Transportation and Communications, Provincial Roads Planning Office, Page VI.

5.3.2 GROWTH BY TRIP GENERATORS

Table 5.8 summarizes the forecasted growth in external traffic by major areas inside and outside the Region. The forecasted increase in traffic within the Region is closely related to projected growth in employment opportunities. The high growth rates in trips from the Hamilton Mountain, Glanbrook, Stoney Creek and Ancaster are related to the plans to establish new industrial parks in these areas. Although the growth rate is high the total traffic from these areas is not nearly as large as from the area of Hamilton below the escarpment.

The projected growth in trips outside the Region is related to expected increases in development. Burlington accounts for the highest growth in impact and also the highest number of external trips. Haldimand-Norfolk and Kitchener-Waterloo will have a significant impact on external travel. Traffic destined to Niagara will grow more slowly but will continue to have a significant impact.

5.3.3 GROWTH BY SCREENLINE

The forecasted growth in p.m. peak hour traffic between 1976 and 2001 is summarized by screenline in Table 5.9. The screenline locations are shown in Figure 5.11.

The annual growth in traffic is forecasted between 2 percent and 5 percent. The largest forecasted growth is at the Highway 403 corridor. The lowest growth is at the north Burlington screenline and the Niagara screenline. The traffic crossing all other screenlines is projected to grow at about the same rate of approximately 4 percent per annum.

Highway 403 and the Q.E.W. although included in the data for screenline 6 have been shown separately in Table 5.9 because of the significant use of these roads by external traffic.

TABLE 5.8

GROWTH BY AREA INSIDE AND OUTSIDE REGION

GEOGRAPHIC AREA	EXTERNAL TRAFFIC				
	1976 (VOL)	2001 (VOL)	CHANGE (VOL)	ANNUAL GROWTH (%)	PERCENT CHANGE (%)
INTERNAL					
ANCASTER	161	387	+ 226	3.57	240
DUNDAS	210	326	+ 116	1.77	55
FLAMBOROUGH	937	1,210	+ 273	1.03	129
GLANBROOK	90	402	+ 312	6.17	447
HAMILTON (LOWER)	5,301	9,729	+4,428	2.46	183
HAMILTON (MOUNTAIN)	782	1,685	+ 903	3.12	215
STONEY CREEK	663	2,527	+1,864	5.50	381
EXTERNAL					
BURLINGTON	4,099	11,850	+7,751	4.34	289
NIAGARA PENINSULA	3,230	4,825	+1,595	1.62	149
HALDIMAND-NORFOLK	1,005	2,586	+1,581	3.85	257
SOUTH-WEST ONTARIO	1,207	2,843	+1,636	3.49	236
WATERLOO, GREY, BRUCE	806	2,227	+1,421	4.15	276
METRO TORONTO, PEEL	906	1,699	+ 793	2.55	187
NORTH EAST ONTARIO	949	1,152	+ 203	0.78	121

TABLE 5.9

EXTERNAL TRAFFIC GROWTH BY SCREENLINE

SCREENLINE LOCATION	1976 VEHICLE ASSIGNMENT (OUTBOUND)	2001 VEHICLE ASSIGNMENT (OUTBOUND)	% CHANGE 1976 TO 2001 (25 YEAR)	ANNUAL GROWTH (%)
1. East Region (Niagara Bound)	3,200	4,890	153	1.7
2. South Region (Haldimand-Norfolk)	960	2,420	252	3.8
3. West Region (South West Ontario)	1,120	2,690	240	3.6
4. North West Region (Kitchener, Grey, Bruce)	910	2,250	247	3.7
5. Burlington North (North Bur.)	460	650	141	1.4
6. North East Region (Toronto Bound)	6,280	17,590	280	4.2
6. a) Q.E.W. Skyway	3,330	8,600	258	3.9
6. b) Hwy. 403	2,480	8,010	323	4.8
TOTAL	12,870	30,400	236	3.5

5.3.4 FORECASTED TRAFFIC ROUTING

Figure 5.15 shows forecasted peak hour traffic assigned by computer to a simulation of the existing road network. The figure shows both the through and the destined external traffic.

By the year 2001 both the Q.E.W. and Highway 403 will be used by substantial volumes of through traffic. Highway 6 north toward Guelph will carry a majority of through traffic. Seventy-five percent of the traffic on Highway 6 south is destined to the Region. The through traffic assigned utilizes the Provincial Highways with no noticeable impact on the existing Regional Roads.

Upper James Street, King, Main, York, Burlington, Wellington and Victoria continue to be the Regional Roads which carry the majority of external destined traffic. Highway 20 (Centennial Drive) is forecasted to be used by significant volumes of both external through and destined traffic.

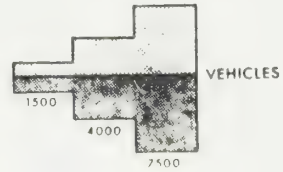
Fig. 5.15

LEGEND

THROUGH TRAFFIC

DESTINED TRAFFIC

SCALE: 1" = 6200 VEHICLES



2001 PEAK HOUR TRAFFIC ASSIGNMENT

Planning & Development Department
Hamilton - Wentworth Region

6.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions contained in this chapter are based mainly on the information in this study. The conclusions are concerned with the present and future traffic patterns, the need for road network improvements, and the potential of transit. Some conclusions are also made regarding the reliability of the information produced in this study.

6.1 TRAFFIC DISTRIBUTION

The City of Hamilton is and will continue to be an employment, service and retail center servicing not only the Hamilton-Wentworth Region but the surrounding regions and municipaliites. Therefore, Hamilton will continue to have a significant interaction with the surrounding regions. The principle traffic generators will continue to be downtown Hamilton and the Bay Front industrial area with secondary generators at the other industrial areas, McMaster University, the Mount Hope Airport, and major retail shopping areas.

The majority of traffic commuting into the Region is from the Burlington Area. Forecasts show that Burlington will continue to be the main area interacting with Hamilton-Wentworth in the future. The projections also show a substantial increase in commuting from residential areas in Hamilton to employment opportunities in Burlington.

The percentage of peak hour external traffic from Haldimand-Norfolk relative to total peak hour external traffic in Hamilton-Wentworth will increase from 8 percent to approximately 10 percent. Waterloo oriented traffic is also

expected to increase slightly its impact on external traffic. The relative importance of external traffic from all other areas, except for those identified previously, will either remain constant or diminish, although in all areas the actual traffic volumes will increase.

It is concluded that through traffic affects mainly the provincial highways in the Region. No new highway route is required specifically to accommodate this through traffic although some existing highways will have to be improved as the traffic flows increase. External destined traffic will continue to be oriented towards the major employment and retail centers in Hamilton and will require some improvements to the roads joining the highway system to downtown Hamilton and the Bay Front industrial area.

The majority of new industrial development is planned in areas immediately accessible to the provincial highway system and therefore require no major improvement to the Regional road system to accommodate external traffic. The industrial area on the east Hamilton Mountain and in Glanbrook is served by only Highway 20 and Highway 53 and is less accessible to externally oriented traffic. Some improvements will be required to the road system in this area to increase the accessibility to the Q.E.W. and Highway 403.

6.2 TRAFFIC PATTERNS

The roads in the Region most effected by external traffic are the Q.E.W., Hwy. 403 and Hwy. 2. These roads carry the majority of the traffic that passes through the Region. The Q.E.W. and Hwy. 403 are used by the vast majority of traffic between Hamilton-Wentworth and Burlington. The Q.E.W. Skyway is presently operating at capacity in the p.m. peak hour with approximatley one-half

of the traffic being through traffic and the other half from Hamilton-Wentworth. Highway 403 is presently operating slightly over one-half of its theoretical capacity in the peak hour with through traffic accounting for slightly less than half the traffic volume.

Highway 6 north is the major connector between Hamilton-Wentworth and the Kitchener-Waterloo and Guelph area. This road is used by the majority of traffic between those areas and Hamilton. This highway is also a major connector between Highway 401 and the Q.E.W. and is used by substantial volumes of through traffic. All other provincial highways in the Region are operating well below capacity.

The external destined traffic utilizes mainly Upper James, King Street, Main Street, Burlington Street, Wellington Street and Victoria Streets by which to connect between the provincial highway system and the major traffic generators in the Region. Although the external traffic alone is not close to the capacity of these roads, the roads are used heavily by local traffic and combined traffic is near capacity in all cases.

The forecasts of p.m. peak hour external traffic to the year 2001 show that a number of highway facilities will be over capacity. These include:

- The Q.E.W. Skyway
- Highway 403 east of King Street
- Highway 6 northbound

In addition, Highway 6 southbound will be operating at capacity. External traffic will significantly contribute to conjestion on Centennial Drive and traffic will far exceed the capacity of this road when local traffic is taken into consideration.

External traffic movements on Burlington, King, Main, Upper James, Wellington and Victoria will increase substantially. The total traffic requirements including local traffic movements will be in excess of the capacity of these roads.

6.3 ROAD IMPROVEMENTS REQUIRED

The forecasts of external traffic movements and the resulting road capacity deficiencies lead to the following conclusions about the road system:

6.3.1 Q.E.W. SKYWAY

The Q.E.W. Skyway is at capacity now and traffic volumes will continuously increase throughout the planning period. If an adequate level of traffic service and accessibility into the Hamilton-Wentworth Region are to be maintained, the road capacity in the Beach Strip must be increased in the immediate future.

The high percentage of Hamilton-Burlington commuter traffic in this corridor suggests that an improved arterial road connection across the Beach Strip will provide some short term relief to traffic conjestion on the Skyway Bridge. Such an improvement will delay for only a short period of time, the need to expand the Q.E.W. to an eight lane facility in this corridor.

6.3.2 HIGHWAY 403

Although traffic on Highway 403 is now well below the capacity of the roadway, the traffic is forecasted to increase substantially by the turn of the century. Highway 403 is expected to be at least one lane over capacity. The majority of traffic on this road link will be between Hamilton and Burlington. Some of this traffic

might be diverted to York Street and Plains Road if that route is maintained as a fast connection. With the parallel arterial route, an eight lane Highway 403 could serve the traffic requirements to the year 2001.

Highway 403 and Highway 2 towards Brantford will provide sufficient highway capacity to meet traffic demands to the year 2001. However, the need for a strategic highway link to Hwy. 401 and the London area require that this road be completed before the turn of the century. The westerly extension of Highway 403 adds considerably to the capacity problems on this highway north of King Street.

6.3.3 HIGHWAY 6 NORTH

Highway 6 north is operating near capacity in the peak hour. External traffic combined with local traffic is close to the capacity of the Clappison Cut between Highway 403 and Highway 5. The northern two lane section of this road is also near capacity. By the year 2001, the two lane section of the road will no longer be sufficient and a minimum of four lanes will be required along the length of the road. The Clappison Cut will also be beyond capacity and improvements will be required between Highway 403 and Highway 5.

The traffic forecasts show that a majority of the future traffic on Highway 6 will be through traffic between Highway 401 and Highway 403. In order to accommodate this traffic in a safe and efficient manner, it is necessary that access to Highway 6 be strictly limited or improvements be made on a new alignment with controlled access.

Direct access to critical areas of Hwy. 6 should be eliminated through the implementation of service roads or the acquisition of property.

6.3.4 HIGHWAY 6 SOUTH

The traffic projections show that the Highway 6 south towards Haldimand-Norfolk could suffice until the turn of the century. The problem with Highway 6 is that it connects directly into the arterial road system in the City of Hamilton necessitating that a relatively large volume of through traffic travel on conjested roads through existing and proposed development. Since the vast majority of through traffic is destined for points towards Burlington and Metro Toronto, a westerly realignment providing direct access to Highway 403 would provide the best bypass route. This connection would also serve the majority of external traffic which is destined to downtown Hamilton and provide access to the Bay Front Industrial area once the Perimeter Industrial Road is completed. A realignment in this manner would also improve accessibility to the airport at Mount Hope.

6.3.5 HAMILTON SOUTHERN FREEWAY BYPASS

The existing and forecasted volumes of traffic travelling through the Region are not sufficient by themselves to justify the construction of a southern highway bypass of the City of Hamilton. Analysis shows that the majority of this traffic now utilizes Highway 53 and Highway 20. Highway 53 expanded to four lanes, will be capable of accommodating this traffic to the turn of the century but other studies[1] have shown that the capacity of Highway 20 will be exceeded by local traffic demands long before the turn of the century.

The need for a mountain-east-west and north-south freeway, although not justified by external and through traffic, has been shown to be required for traffic demands within the City of Hamilton[1].

---

1. Regional Official Plan - Transportation Impacts Report; Saltfleet Community Development-Transportation Impacts Study, Mountain E-W/N-S Corridor Study.

A major north-south and east-west freeway constructed to serve internal traffic requirements will also serve the external traffic requirements and could divert a significant volume of traffic from the Q.E.W. Skyway.

6.3.6 BURLINGTON STREET EAST

There are now severe capacity limitations on Burlington Street East. Existing external and local traffic demands are equal to the capacity of the road and forecasts show that both the external and local traffic demands will increase. External traffic will approximately double to the year 2001. A separate study[1] done by the Region shows that a major road improvement must be completed before 1985.

6.3.7 INDUSTRIAL PERIMETER ROAD

External traffic demands between Highway 403 and the Bay Front Industrial area and downtown Hamilton will greatly increase by the turn of the century. By that time the demands will require approximately seven arterial lanes in each direction. When combined with local traffic demands, the existing capacity of King, Main, York, and Aberdeen Streets will be greatly exceeded. The construction of a new road between Hwy. 403 and Burlington Street could divert a substantial portion of this externally oriented traffic away from the existing streets by providing direct access to the Hamilton downtown area and the Bay Front industrial area.

---

1. Reconstruction of Burlington Street, Regional Engineering Department, 1978.

The construction of the Perimeter Road will reduce the requirements for future capacity improvements of existing east-west streets into the downtown area. That road will also divert some external traffic off the Q.E.W. Skyway and Burlington Street East by providing an alternative route to the Bay Front industrial area.

6.3.8 REGIONALLY SIGNIFICANT ROAD CONNECTIONS

A number of arterial roads within the City of Hamilton are heavily utilized by externally oriented traffic. Some of these roads will have severe capacity problems if the projected volumes of external traffic remain on these roads along with local traffic movements. The main areas of concern are:

1. Upper James Street
2. King, Main, and York Streets between Hwy. 403 and downtown Hamilton.
3. Burlington Street East, and
4. Centennial Drive (Hwy. 20)

These roads are also used by external truck traffic. The external traffic is not always compatible with slower moving local traffic and local development. It is advisable, where possible, to build alternative routes for some of this traffic rather than expand these roads to accommodate the traffic.

External traffic on Upper James Street can be substantially diverted by a realignment of Highway 6 to connect directly to Hwy. 403. The construction of an east-west freeway would further divert remaining traffic. External traffic on King, Main, and York Streets can be substantially diverted by the construction of the Industrial Perimeter Road. External traffic on Burlington Street East will have to be accommodated by improvement to that road. Expansion plans for this road segment will accommodate the traffic at a

high level of service. External traffic on Centennial Drive (Hwy. 20) will be reduced significantly if a new parallel north-south roadway is constructed.

6.4 POTENTIAL TRANSIT CONNECTION

Where there are heavy traffic movements of private automobiles there exists some potential for transit service. Since transit usage is dependant on a number of factors, the areas designated in this report should be considered for further investigation and no final conclusions should be drawn at this time.

The largest commuting interchange is between Burlington and Hamilton. This area has a great potential for expanding the existing transit service. The existing commuter pattern and the projected expansion of the downtown show that Hamilton would be the logical focal of this commuter transit service and the Bay Front industrial area is a logical secondary focus point. In Burlington, there is no one focus point for this type of transit service since it would be oriented towards low and medium density residential development. A significant expansion of commuter service from Burlington will depend on a good system of feeder buses and park and ride facilities.

The routing of commuter service between Hamilton and Burlington will require primary orientation in the 403 corridor with secondary orientation along the Beach Strip corridor. These potential transit commuters could be served by an extension of GO Train services but would not by themselves justify the full extension of GO Train services. Express bus routes would best serve the division of trip ends in Hamilton and the dispersed trip ends in Burlington.

Other potential areas of expanding inter-city transit service are Nanticoke, Brantford, Grimsby, Kitchener-Waterloo, and Guelph. Bus transit will be sufficient to meet these potential needs. The projected increase in commuter traffic between Hamilton and Metro Toronto is not sufficient to justify a significant expansion in transit service between the two cities.

6.5 ACCURACY OF FORECASTS

The accuracy of the forecasts of external traffic movements and the conclusions drawn from those projections are dependent on the traffic forecast technique. The traffic forecasts in this study are based on the Fratar Factoring Technique. This technique, although based on a relatively simple theory, is judged to be the best method available at this time.

The reliability of the technique was checked in a number of ways, including:

1. calibrating base year simulation to traffic counts,
2. comparing geographic distribution of trip interchanges with Census Canada place of work/place of residence data, and
3. comparing projected traffic growth rates to past traffic growth rates.

As a result of these checks, it was conluded that the traffic forecasts are a reliable base on which to make long range transportation planning decisions. However, it must be cautioned that the traffic projections are based on assumptions concerning land use development and travel behaviour characteristics.

percent if a comprehensive program of staggered work hours and modified work weeks is implemented in the City of Hamilton.

Car ownership has been increasing rapidly in the immediate past. This study assumes that this rapid increase will not continue and the rate of car ownership will remain reasonably constant. To assume that the rate of car ownership will decrease significantly would require that the relative economic conditions must decline.

The study has looked at the potential of transit to serve external traffic requirements. Because of the dispersed trip ends it would be unrealistic to assume that transit service will have a significant impact on external traffic volumes. Efforts should concentrate on providing transit service that is a viable alternative to the automobile in specific corridors.

Parking rates in the downtown area or other areas of concentrated development can have an impact on auto usage of urban travellers. However, external traffic is less responsive to parking rates. The trip length and the lack of a viable transit alternative make these trips more dependent on automobiles. Drastic changes in parking charges will produce only minimal changes in external auto traffic.

6.6 RECOMMENDATIONS

The results of this study have indicated the importance of external traffic when making decisions concerning transportation facilities. As a result of this study, a number of conclusions were made concerning the transportation system. These conclusions must be acted upon and the information on which they are based must be monitored.

As a result of the findings of this study the following recommendations are made:

1. The results of this study be used as a data supplement in transportation decision making by the Region and that further study of specific major transportation improvements incorporate the findings of this study. Specifically, the findings of this study should be input to:

   (a) The Mountain East-West and North-South Transportation Corridor Study that is now underway, and

   (b) Monitoring the need for and timing of the Hamilton Industrial Perimeter Road.

2. The Region forward the results of this study to the Provincial Ministry of Transportation and Communications with the request that the study findings be used in transportation decision making by the Province.

3. The Region request the province to take appropriate action to implement improvements to the Provincial Highway System that are consistant with the findings of the study. Specifically, the Region:

   (a) Supports Provincial action to immediately construct a four lane arterial to relieve existing traffic conjestion on the Skyway and to expand the Q.E.W. crossing the Beach Strip to eight lanes by the mid 1980's.

   (b) Requests the Province to plan, in consultation with the Region, a new alignment for Highway 6 south of the City of Hamilton that will provide direct connection to the existing or planned freeway system in Hamilton.

(d) Request the Province to implement stringent access controls on Highway 6 north of Highway 403 with the objective of maintaining this as a high speed highway connection between Highway 403 and Highway 401. The Province is also requested to monitor the need for further improvements to this Highway between Highway 403 and Highway 401.

(e) Encourage the Province to continuously monitor traffic conditions on Highway 403 north of King Street and to investigate the potential of expanding this section of Highway when it becomes necessary.

(f) Encourage the Province through the Toronto Area Transit Operating Authority to monitor the need for transit service between the City of Hamilton and the City of Burlington and to initiate programs to encourage the use of this service.

(4) A monitoring program be implemented by the Region to regularly monitor traffic volumes on all roads crossing the Regional boundary. The data from this monitoring program should be used to continuously evaluate the findings and conclusions of this study.

APPENDIX A

SURVEY STATION DESCRIPTION

HIGHWAY OR ROAD	DESCRIPTION	COUNTS	DIRECTION	AADT	% TRUCKS	% DHV	DHV	% DHV TRUCKS	SADT	SAWD
Q.E.W.	East of Junction Regional Road 50 (On Hamilton/ Wentworth - Niagara Regional Line)	Classification Only - bothways - weekday	Eastbound (Assuming 50/50 split) Combined	18,322 36,645	16.3 16.3	12.3 12.3	2,254 4,507	6.0 12.7	26,567 53,135	25,102 50,205
Highway 403	Immediately West of Q.E.W. Interchange (3 ramps) - Also TARMS West Cordon #4	License Plate O.D. - Count & Classification - eastbound only	Ramp to Toronto Ramp to Niagara Eastbound Combined (Assuming 50/50 split)	15,855 6,390 22,240 44,490	15.9 15.9 15.9 15.9	10.1 10.1 10.1 10.1	1,601 645 2,246 4,493	12.7 12.7 12.7 12.7	16,490 6,645 23,135 46,270	18,075 7,285 25,360 50,720
Highway 8	Immediately West of Niagara Regional Sign (In Hamilton-Wentworth)	- O.D. eastbound only - Count & Classification - eastbound only	Eastbound Combined (Assuming 50/50 split)	2,840 5,680	5.8 5.8	11.7 11.7	332 665	4.0 4.0	3,325 6,650	3,095 6,190
Regional Road 25	Immediately East of Niagara Regional Sign (In Niagara)	- O.D. eastbound only - Count & Classification	Eastbound (Rained out) Combined	- 690	- 21.9*	- 12.4	- 86	- -	- 885	- 840
Regional Road 11	0.20 Miles East of Niagara Regional Sign (In Niagara)	- O.D. eastbound only - Count & Classification	Eastbound Combined (Assuming 50/50 split)	490 980	14.8 14.8	12.4 12.4	61 122	4.4 4.4	630 1,260	600 1,200
Highway 20	0.30 Miles West of Niagara Regional Sign (In Hamilton-Wentworth)	- O.D. eastbound only - Count & Classification	Eastbound Combined (Assuming 50/50 split)	2,320 4,640	11.2 11.2	11.7 11.7	271 543	8.7 8.7	2,715 5,430	2,530 5,060
Regional Road 22	0.30 Miles West of Niagara Regional Sign (In Hamilton-Wentworth)	- O.D. eastbound only - Count & Classification	Eastbound Combined (Assuming 50/50 split)	1,175 2,350	7.6 7.6	12.4 12.4	146 291	7.6 7.6	1,505 3,010	1,435 5,060
Highway 56	0.20 Miles North of Junction Regional Road 13	- O.D. southbound only - Count & Classification	Southbound Combined (Assuming 50/50 split)	1,415 2,830	8.4 8.4	12.4 12.4	175 351	4.5 4.5	1,810 3,620	1,725 3,450
Highway 6	0.20 Miles North of Regional Sign (In Hamilton-Wentworth)	- O.D. southbound only - Count & Classification	Southbound Combined (Assuming 50/50 split)	4,695 9,390	10.9 10.9	13.2 13.2	620 1,239	5.1 5.1	4,975 9,950	5,305 10,610
Brant Regional Road 22	Immediately South of Hamilton-Wentworth Regional Road 122	- O.D. southbound - Count & Classification	Southbound Combined (Assuming 50/50 split)	310 620	8.7 8.7	11.7 11.7	36 73	11.7 11.7	365 730	340 680
Regional Road 22	Cancelled									
Highway 2	0.40 Miles West of Sunnyridge Side Road (Jerseyville Road)	- O.D. Westbound - Count & Classification	Westbound Combined (Assuming 50/50 split)	6,550 13,100	14.9 14.9	13.2 13.2	865 1,729	14.3 14.3	6,945 13,890	7,400 14,800
Regional Road 17	Immediately South of Junction Ronald Road	- O.D. Westbound - Count & Classification	Westbound Combined (Assuming 50/50 split)	220 440	7.7 7.7	11.0 11.0	24 48	0 0	245 490	240 480
Highway 97	0.20 Miles West of Waterloo - Hamilton-Wentworth Boundry Sign - Taken under Waterloo Cordon #6	- O.D. both directions - Count & Classification	Eastbound (Assuming 50/50 split) Combined	422 845	6.9 6.9	13.2 13.2	56 113	3.9 3.9	448 895	483 965
Regional Road 18	Immediately East of Regional Sign (In Halton) - Also TARMS West Cordon #9	- O.D. both directions - Count & Classification	Eastbound (Assuming 50/50 split) Combined	463 925	9.9 9.9	12.2 12.2	56 113	3.4 3.4	600 1,200	545 1,090
Regional Road 36	Immediately West of Regional Sign (In Hamilton-Wentworth) - Also TARMS West Cordon #8	- O.D. both directions - Count & Classification	Eastbound (Assuming 50/50 split) Combined	428 855	13.4 13.4	13.5 13.5	58 115	8.8 8.8	565 1,130	470 940
Regional Road 7	0.20 Miles East of Burlington Limits Sign (Course)	- O.D. both directions - Count & Classification	Eastbound (Assuming 50/50 split) Combined	268 535	12.1 12.1	10.1 10.1	27 54	3.4 3.4	278 555	305 610
Highway 5	Immediately West of Burlington Limits Sign - Also TARMS West Cordon #6	- O.D. both directions - Count & Classification	Eastbound (Assuming 50/50 split) Combined	3,533 7,065	8.7 8.7	13.2 13.2	466 933	5.5 5.5	3,745 7,490	3,993 7,985
Regional Road 9 - Mill Street South (at American Tavern in Waterdown)	Immediately South of Regional Line Sign (Between Horny Road and Line) (Note one man required or 3rd Concession Road) - Also TARMS West Cordon #5	- O.D. both directions - Count & Classification	Southbound (Assuming 50/50 split) Combined	1,910 3,820	1.9 1.9	10.1 10.1	193 386	2.2 2.2	1,985 3,970	2,178 4,355

HIGHWAY OR ROAD	DESCRIPTION	COUNTS	DIRECTION	AADT	% TRUCKS	% DHV	DHV	% DHV TRUCKS	SADT	SAWD
Highway 2 (Plains Road)	0.40 Miles East of Junction Highway 6 Ramp (Burlington Sign) - Also TARMS West Cordon #3	- O.D. both directions - Count & Classification	Eastbound (Assuming 50/50 split) Combined	7,600 15,200	7.7 7.7	10.1 10.1	768 1,535	4.5 4.5	7,905 15,810	8,665 17,330
Q.E.W. Ontario Street Interchange 115	Q.E.W. Eastbound Off Ramp - to Maple, Ontario and Christie Streets - Grimsby	- O.D. eastbound Only (ramp) - Count & Classification	Eastbound	1,420	7.7	10.1	143	2.5	1,475	1,620
Q.E.W. Casablanca Interchange 120	Q.E.W. Eastbound Off Ramp - to Casablanca Road	- O.D. eastbound Only (ramp) - Count & Classification	Eastbound	1,300	6.0	10.1	131	2.6	1,350	1,480
Q.E.W. Eastbound	Cancelled	- Truck O.D. only								
Q.E.W. Westbound	Truck Inspection Station Westbound - West of Fruitland Road	- Truck O.D. only	Westbound Combined (Assuming 50/50 split	20,556 41,100	14.4 14.4	13.5 13.5	2,774 5,549	16.1 16.1	27,125 54,250	22,605 45,210
Burlington Skyway	Old Toll Plaza (Also TARMS West Cordon #1)	License Plate O.D. - Count & Classification - northbound only	Northbound Combined (Assuming 50/50 split)	23,660 47,330	15.5 15.5	13.2 13.2	3,123 6,248	10.8 10.8	25,080 50,160	26,735 53,470
Highway 20 Northbound	Ramp to Toronto and back from Bullnose (on Q.E.W.)	- Truck O.D. only	Northbound On Ramp for (24/12) Factor = 1.49	6,500	9.0	10.1	657	7.7	6,760	7,410
Q.E.W.	Cancelled									
Beach Strip	Beach Boulevard at Bridge (Also TARMS West Cordon #2)	- O.D. both directions - Weekday - Count & Classification	Northbound (Assuming 50/50 split) Combined	4,538 9,075	4.4 4.4	10.1 10.1	458 917	2.2 2.2	4,720 9,440	5,123 10,345
Q.E.W. Ontario Street Interchange 105	Q.E.W. Eastbound Off Ramp - to Ontario Street (Beamsville)	- O.D. eastbound Only (ramp) - Count & Classification	Eastbound	1,095	17.4	10.1	111	8.6	1,140	1,250
Q.E.W. Park Road Interchange 110	Q.E.W. Eastbound Off Ramp - to Park Road	- O.D. eastbound Only - Count & Classification	Eastbound	530	7.1	10.1	54	2.0	550	605
Highway 99	Immediately East of Regional Line Sign - (In Hamilton/Wentworth)	- O.D. Westbound - Count & Classification	Westbound (Assuming 50/50 split) Combined	768 1,535	8.2 8.2	11.0 11.0	84 169	2.2 2.2	853 1,705	838 1,675
Highway 5	Immediately East of Regional Line Sign (In Hamilton-Wentworth)	- O.D. westbound - Count & Classification	Westbound (Assuming 50/50 split) Combined	1,003 2,005	14.7 14.7	12.4 12.4	124 249	12.8 12.8	1,283 2,565	1,223 2,445
Highway 6	Immediately South of Regional Line Sign	- O.D. northbound - Count & Classification	Northbound Combined (Assuming 50/50 split)	4,195 8,390	20.1 20.1	11.0 11.0	461 923	9.9 9.9	4,655 9,310	4,575 9,150
3rd Concession Road	Immediately West of Regional Road 9 (Taken as part of station 19)	- O.D. both directions - Count & Classification	Combined (included in Station 19)							
Highway 8	0.20 Miles West of Vanier Road	- O.D. both directions - Count & Classification	Westbound (Assuming 50/50 split) Combined	2,465 4,930	12.1 12.1	12.4 12.4	306 612	8.2 8.2	3,155 6,310	3,008 6,015

APPENDIX B

SURVEY QUESTIONNAIRES

B1. Roadside Passenger Vehicle Interview Form

B2. Roadside Truck Interview Form

B3. Q.E.W. Skyway Licence Plate Survey Form

B4. Hwy. 403 Licence Plate Survey Form.

Ministry of Transportation and Communications (Ontario)

PAGE NO	STUDY NO	STATION	DIRECTION	TIME ENDING	DAY, MONTH, YEAR
1 2 3	4 5 6	7 8	9	10 11 12 13	14 15 16 17 18 19

LINE	VEHICLE TYPE	NO. IN VEHICLE	INITIAL ORIGIN: CITY, TOWN; WHERE DID THIS TRIP BEGIN: CITY, TOWN; ADDRESS NO. STR/LOT CONC	TYPE OF ESTNT AT ORIGIN	FINAL DESTINATION: CITY, TOWN; WHERE WILL THIS TRIP END: CITY, TOWN; ADDRESS NO. STR/LOT CONC	TYPE OF ESTNT AT DESTINATION	DRIVER TRIP PURPOSE	DR. CH. MODE	PASS TRIP PURPOSE	PA. CH. MODE	DURATION	HOME BASE	TRIP FREQ	DR. SEAT BELTS	PASSENGERS SEAT BELTS
20	21 22	23 24	25 26 27 28 29 30 31 32 33 34	35 36	37 38 39 40 41 42 43 44 45 46	47 48	49 50	51	52 53	54	55	56	57 58	79	80
1															
2															
3															

VEHICLE TYPE
1 PASSENGER VEHICLE
2 LIGHT 2-AXLE TRUCK (SINGLE REAR TIRES)
6 BUS
7 TAXI
8 VEHICLE PULLING TRAILER
9 MOTORCYCLE
0 OTHER - SPECIFY

PREFIX VEHICLE TYPE CODE BY
0 IF ONTARIO LICENCE
1 IF OTHER PART OF CANADA
2 IF FOREIGN LICENCE

PB - TB - 54 5 - 75

TYPE OF ESTABLISHMENT
10 RESIDENTIAL
20 RETAIL
30 WHOLESALE
40's PUBLIC SERVICE - (SPECIFY)
50's RECREATIONAL - (SPECIFY)
60's MANUFACTURING - (SPECIFY)
70's CONSTRUCTION - (SPECIFY)
80's OTHER (SPECIFY)
90's AGRICULTURE - (SPECIFY)

TRIP PURPOSE
10 WORK
11 COMMUTER
12 BUSINESS - SALES
13 SERVICE - ROUTE
20 PERSONAL BUSINESS
21 EAT MEAL
22 PROFESSIONAL SERVICES
23 BANK
24 MEETINGS
26 VISIT
26 FUNERAL
29 OTHER
31 SHOPPING
40 SCHOOL
41 SECONDARY
42 UNIVERSITY OR COLLEGE
43 PRIMARY
49 OTHER
50 RECREATION
51 PICNIC
52 CAMPING
53 COTTAGE
54 DAY TRIP
55 OUTDOOR SPORTS
56 INDOOR SPORTS
57 TOURING
58 ENTERTAINMENT
61 SERVE PASSENGERS

CHANGE MODE OF TRAVEL TO
1 AUTO
2 BUS
3 RAIL
4 AIR
5 WATER
6 URBAN TRANSIT

DURATION
1 ONE DAY OR LESS
2 TO 8 DAYS
9 NINE DAYS OR MORE

HOME BASE OF VEHICLE
1 ORIGIN
2 DESTINATION
3 NEITHER O NOR D
4 INITIAL ORIGIN
5 FINAL DESTINATION

TRIP FREQUENCY
01 09/DAY
11-19/WEEK
21 29/MONTH
31-39/YEAR

DRIVER SEAT BELTS
1 NO BELTS INSTALLED
2 NOT WEARING BELTS
3 WEARING LAP BELT ONLY
4 WEARING SHOULDER BELT ONLY
5 BOTH LAP AND SHOULDER
9 NOT OBSERVED

PASSENGERS WEARING SEAT BELTS
0 TO 8
IF NO PASSENGERS OR NOT OBSERVED CODE NINE (9)

AUTO O-D SURVEY INTERVIEWS

Ministry of Transportation and Communications
Ontario

PAGE NO	STUDY NO	STATION	DIRECTION	TIME ENDING	DAY, MONTH, YEAR
1 2 3	4 5 6	7 8	9	10 11 12 13	14 15 16 17 18 19

VEHICLE TYPE
1. BOX
2. VAN
3. STAKE/FLAT BED
4. TANK
5. CEMENT MIXER
6. CONTAINER
7. AUTO CARRIER
8. OTHER SPECIFY

LINE	VEHICLE TYPE	P.C.V.	AXLE COUNT	UNITS	ORIGIN / DESTINATION	TYPE OF ESTABL.	TRIP PURPOSE	BASE CODE	TRIP FREQUENCY	LOAD TYPE	LICENCE NO. / LOAD WEIGHT
20	21 22	23	24	25	26 27 28 29 30 31 32 33 34 35 / 36 37 / 38 39 40 41 42 43 44 45 46 47	48 49	50	51	52 53	74 75 76	77 78 79 80
1											
20	21 22	23	24	25	26 27 28 29 30 31 32 33 34 35 / 36 37 / 38 39 40 41 42 43 44 45 46 47	48 49	50	51	52 53	74 75 76	77 78 79 80
2											
20	21 22	23	24	25	26 27 28 29 30 31 32 33 34 35 / 36 37 / 38 39 40 41 42 43 44 45 46 47	48 49	50	51	52 53	74 75 76	77 78 79 80
3											

GRAPHIX VEHICLE TYPE CODE BY
0 - IF ONTARIO LICENCE
1 - IF OTHER PART OF CANADA
2 - IF FOREIGN LICENCE

P.C.V.
0 NONE
1 YES
2 L TYPE

UNITS
CODE 1 SINGLE
CODE 2 TWO UNITS
CODE 3 THREE UNITS

TYPE OF ESTABLISHMENT
10 RESIDENTIAL
20 RETAIL
30 WHOLESALE
40's PUBLIC SERVICE (SPECIFY)
50's RECREATIONAL - (SPECIFY)
60's MANUFACTURING - (SPECIFY)
70's CONSTRUCTION - (SPECIFY)
80's OTHER - (SPECIFY)
90's AGRICULTURE - (SPECIFY)

TRIP PURPOSE
1. PICK UP GOODS
2 DELIVER GOODS
3 PICK UP & DELIVER
4 TRANSFER GOODS
5. TO BASE OF OPERATIONS
6 SERVICE
7. PERSONAL BUSINESS
8. OTHER (SPECIFY)

BASE CODE
1 ORIGIN
2. DESTINATION
3. OTHER

TRIP FREQUENCY
01 - 09/DAY
11 - 19/ WEEK
21 - 39/ MONTH
31 - 39/ YEAR

LOAD TYPE
1 AGRICULTURE (SPECIFY)
2 FORESTRY
3 MINES, QUARRIES, OIL WELLS (SPECIFY)
4 MANUFACTURED (SPECIFY)
5 GENERAL FREIGHT
6 SCRAP & WASTE MATERIAL
7 NOT APPLICABLE
8 EMPTY

PB-TS-34A 5-75

TRUCK O-D SURVEY INTERVIEWS

RE OTHER TYPES OF TRANSPORTATION USED ON THIS TRIP, IN addition TO UR CAR? (Please check if applicable)

	DRIVER	PASSENGER		DRIVER	PASSENGER
1. Auto	☐	☐	4. Airplane	☐	☐
2. Bus	☐	☐	5. Boat or Ferry	☐	☐
3. Train	☐	☐	6. Urban Transit	☐	☐

W FREQUENTLY DO YOU MAKE A TRIP IN THIS DIRECTION FOR THE SAME RPOSE? (Please specify)

1. Times per Day _____
2. Times Per Week _____
3. Times per Month _____
4. Less Frequently _____

S THIS TRIP PART OF A LONGER JOURNEY? (As a vacation or business)

YES ☐ NO ☐

YES, PLEASE INDICATE:

1. The Duration of the Journey (Days) _____
2. Journey Start Point _____ Town/City _____
3. Journey End Point _____ Town/City _____

YOU HAVE ANY COMMENTS PLEASE INDICATE BELOW.

_____

_____

_____

_____

_____

_____

_____

ANK YOU FOR YOUR CO-OPERATION.

_____

SE ANSWER THE FOLLOWING QUESTIONS, IF YOU TRAVELLED NORTHBOUND ON EW, on the BURLINGTON SKYWAY, ON TUESDAY, JULY 6, 1976 AND RETURN THE TIONNAIRE IN THE ENCLOSED, PREPAID ENVELOPE.

CIRCLE THE TIME OF TRAVELLING ON HIGHWAY 403 TO THE CLOSEST HOUR.

M. 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 P.M.

HE TYPE OF VEHICLE USED WAS: (Please check one)

1. ☐ Passenger Car
2. ☐ Light 2-Axle Truck (Single Rear Tires)
3. ☐ Taxi
4. ☐ Vehicle Pulling Trailer

PLEASE INDICATE WHERE THIS TRIP STARTED:

Address or Nearest
Major Intersection _____
Town/City _____

WHAT WAS THE TYPE OF ESTABLISHMENT WHERE THIS TRIP STARTED?
(Please check one)

1. ☐ Residential
2. ☐ Retail
3. ☐ Wholesale
4. ☐ Public Service
5. ☐ Recreational
6. ☐ Manufacturing
7. ☐ Construction
8. ☐ Other (Please specify)

Ministry of Transportation and Communications
Ontario

File: R520.11

Regional Municipality of Hamilton – Wentworth

BURLINGTON SKYWAY TRAFFIC SURVEY

Tues. July 6, 1976

5. INCLUDING THE DRIVER, HOW MANY PERSON(S) WERE IN THE MOTOR VEHICLE, DURING THIS TRIP _____

6. PLEASE INDICATE WHERE THIS TRIP ENDED:

Address or Nearest
Major Intersection _____
Town/City _____

7. WHAT WAS THE TYPE OF ESTABLISHMENT WHERE THIS TRIP ENDED?
(Please check one)

1. ☐ Residential
2. ☐ Retail
3. ☐ Wholesale
4. ☐ Public Service
5. ☐ Recreational
6. ☐ Manufacturing
7. ☐ Construction
8. ☐ Other (Please specify)

8. WHAT WAS THE PURPOSE OF THIS TRIP? (Please check one)

	DRIVER	PASSENGER(S) (IF ANY)
1. Work	☐	☐
2. Personal Business	☐	☐
3. Shopping	☐	☐
4. School	☐	☐
5. Recreation	☐	☐
6. Serve Passenger	☐	☐
7. Other (Please specify)	☐ _____	☐ _____

9. WHERE IS THE VEHICLE NORMALLY KEPT? (Please check one)

1. ☐ Where the trip started
2. ☐ Where the trip ended
3. ☐ Other?

(See Over)

ERE OTHER TYPES OF TRANSPORTATION USED ON THIS TRIP, IN addition TO
OUR CAR? (Please check if applicable)

	DRIVER	PASSENGER		DRIVER	PASSENGER
1. Auto	☐	☐	4. Airplane	☐	☐
2. Bus	☐	☐	5. Boat or Ferry	☐	☐
3. Train	☐	☐	6. Urban Transit	☐	☐

HOW FREQUENTLY DO YOU MAKE A TRIP IN THIS DIRECTION FOR THE SAME
URPOSE? (Please specify)

1. Times per Day _____
2. Times Per Week _____
3. Times per Month _____
4. Less Frequently _____

AS THIS TRIP PART OF A LONGER JOURNEY? (As a vacation or business)

YES ☐ NO ☐

IF YES, PLEASE INDICATE:

1. The Duration of the Journey (Days) _____
2. Journey Start Point _____ Town/City _____
3. Journey End Point _____ Town/City _____

YOU HAVE ANY COMMENTS PLEASE INDICATE BELOW.

_____

_____

_____

_____

_____

_____

_____

NK YOU FOR YOUR CO-OPERATION.

Ministry of Transportation and Communications
Ontario

File R520.11

Regional Municipality of Hamilton – Wentworth

HIGHWAY 403
TRAFFIC SURVEY

Tues. June 22, 1976

EASE ANSWER THE FOLLOWING QUESTIONS, IF YOU TRAVELLED EASTBOUND ON
WAY 403, IMMEDIATELY EAST OF HIGHWAY 6, ON TUESDAY JUNE 22, 1976 AND
RN THE QUESTIONNAIRE IN THE ENCLOSED, PREPAID ENVELOPE.

CIRCLE THE TIME OF TRAVELLING ON HIGHWAY 403 TO THE CLOSEST HOUR.

A.M. 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 P.M.

THE TYPE OF VEHICLE USED WAS: (Please check one)

1. ☐ Passenger Car
2. ☐ Light 2-Axle Truck (Single Rear Tires)
3. ☐ Taxi
4. ☐ Vehicle Pulling Trailer

PLEASE INDICATE WHERE THIS TRIP STARTED:

Address or Nearest
Major Intersection _____
Town/City _____

WHAT WAS THE TYPE OF ESTABLISHMENT WHERE THIS TRIP STARTED?
(Please check one)

1. ☐ Residential
2. ☐ Retail
3. ☐ Wholesale
4. ☐ Public Service
5. ☐ Recreational
6. ☐ Manufacturing
7. ☐ Construction
8. ☐ Other (Please specify)

5. INCLUDING THE DRIVER, HOW MANY PERSON(S) WERE IN THE MOTOR VEHICLE DURING THIS TRIP _____

6. PLEASE INDICATE WHERE THIS TRIP ENDED:

Address or Nearest
Major Intersection _____
Town/City _____

7. WHAT WAS THE TYPE OF ESTABLISHMENT WHERE THIS TRIP ENDED?
(Please check one)

1. ☐ Residential
2. ☐ Retail
3. ☐ Wholesale
4. ☐ Public Service
5. ☐ Recreational
6. ☐ Manufacturing
7. ☐ Construction
8. ☐ Other (Please specify)

8. WHAT WAS THE PURPOSE OF THIS TRIP? (Please check one)

	DRIVER	PASSENGER(S) (IF ANY)
1. Work	☐	☐
2. Personal Business	☐	☐
3. Shopping	☐	☐
4. School	☐	☐
5. Recreation	☐	☐
6. Serve Passenger	☐	☐
7. Other (Please specify)	☐ _____	☐ _____

9. WHERE IS THE VEHICLE NORMALLY KEPT? (Please check one)

1. ☐ Where the trip started
2. ☐ Where the trip ended
3. ☐ Other?

(See Over)

APPENDIX C

FRATAR FACTORING TECHNIQUE

APPENDIX C

Fratar Factoring Technique

The Frator facturing technique calculates future travel patterns based on existing travel patterns and expected changes in the rate of trip making. The technique operates on a base year origin-destination table for a standard period of time (24 hour or peak hour) and modifies each element of that table according to the expected changes of trip production at the trip origin, and trip attraction at the trip destination. The standard fratar equation used for projecting travel patterns to the year 2001 is:

$$T_{ij}^{2001} = FP_i * FA_j * T_{ij}^{1971}$$

where T_{ij}^{2001} = Trip interchange values between origin zone i and destination zone j in horizon year (2001).

FP_i = Trip production factor for zone i indicating change in activity rates for producing trips at the trip origin between 1971 and 2001.

FP_j = Trip attraction factor for zone j indicating change in activity rates for attracting trips at the destination between 1971 and 2001.

T_{ij}^{1971} = Trip interchange values between origin zone i and destination zone j in base year (1971).

For the P.M. peak hour the majority of trips are work trips (73%) and therefore the trip productions were directly related to employment opportunities and the trip attractions were directly related to population. Therefore, the p.m. peak hour growth factors are:

$$\text{(Production Factor)} = (FP_i) = \frac{Emp_i^{2001}}{Emp_i^{1971}}$$

$$\text{(Attraction Factor)} = (FA_j) = \frac{Pop_j^{2001}}{Pop_j^{1971}}$$

where Emp_i^{2001} = Employment in zone i in horizon year.

Emp_i^{1976} = Employment in zone i in base year.

Pop_j^{2001} = Population in zone j in horizon year.

Pop_j^{1976} = Population in zone j in base year.

Trip productions are normalized against trip attractions.

Over a 24 hour period work trips account for 55% of all trips. There is no set direction of travel, therefore, the productions and the attractions are influenced by both population and employment. Investigation of past trends and other studies indicate that employment has twice the influence on the rate of trip making than does population. Therefore, the equations for the 24 hour growth factors are:

$$\text{(Production Factor)} = (FP_i) = \frac{Pop_i^{2001} + 2Emp_i^{2001}}{Pop_i^{1976} + 2Emp_i^{1976}}$$

$$\text{(Attraction Factor)} = (FP_i) = \frac{Pop_j^{2001} + 2Emp_j^{2001}}{Pop_j^{1976} + 2Emp_j^{2001}}$$

where Pop_i^{2001}, Pop_j^{2001} = Population in zone i or zone j for horizon year.

Pop_i^{1976}, Pop_j^{1976} = Population in zone i or zone j for base year.

Emp_i^{2001}, Emp_j^{2001} = Employment in zone i or zone j for horizon year.

Emp_i^{1976}, Emp_j^{1976} = Employment in zone i or zone j for base year.

Attractions are normalized against productions.

The production and attraction of truck traffic is mainly influenced by employment opportunities. It was therefore established that the growth factors for truck traffic for both the peak hour and the 24 hour periods should be based on the change in employment opportunities. The peak hour and 24 hour growth factors for trucks are:

$$\text{(Production Factor)} = (FP_i) = \frac{Emp_i^{2001}}{Emp_i^{1976}}$$

$$\text{(Attraction Factor)} = (FA_j) = \frac{Emp_j^{2001}}{Emp_j^{1976}}$$

where Emp_i^{2001}, Emp_j^{2001} = Employment in zone i or zone j in horizon year.

Emp_i^{1976}, Emp_j^{1976} = Employment in zone i or zone j in base year.

APPENDIX D

EXTERNAL O.D. TABLES

D1. 1976 Observed O.D. Table

D2. 2001 Forecast O.D. Table

D3. External Macro Zones

D4. Internal Macro Zones

VEHICLE DESTINATION ZONES

VEHICLE ORIGIN ZONES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	TOTAL
1																															3	24	18	3	94	111	28	22	303
2																															4	7	3		5	22	8		49
3																															8	47	15			10	23		103
4																															41	265	11	3	31	11	74	2	438
5																															2	39	2		1				44
6																																5	3		2	10			20
7																															29	25	31	8	39	21	27	10	190
8																															4	9	18	12	30	13	6	6	98
9																															3	3	5	7	37	5	3		63
10																																4	18	32	4	3	3		64
11																															5	5	9	7					26
12																																7	10	1					18
13																																5	5	5				4	19
14																															5	15	90	6			10	14	140
15																															33	158	168	32	28	27	22	18	486
16																															40	266	88	28	57	44	28	31	581
17																															31	126	50	47	33	5	30	25	347
18																															131	479	164	133	117	53	97	156	1220
19																															5	21	17	2	4	12	6	3	70
20																															115	647	441	181	99	30	72	49	1634
21																															66	202	93	57	55	63	36	24	586
22																															48	83	137	41	34	33	47	7	430
23																															36	121	136	44	22	31	29	14	433
24																																28	12	4			1		45
25																															16	65	51	34	38	24	14		242
26																															16	73	86	96	22	15	25	11	344
27																															7	26	23	9	6	7	5	10	92
28																																	2	6	2		8	4	22
29																																2	1	14		6			23
30																																	7	7					14
31	5	5	10	39	2		20	2	2		3			3	23	26	22	85	2	78	43	32	25		11	8	5				38	41	36	4	15	34	8	5	594
32	17	5	41	186	22	3	19	7	3	3	4	4	2	9	106	177	79	323	13	438	139	54	79	16	45	52	15		3		30	9	239	76	80	111	2		2410
33	18	5	19	11		5	27	20	2	12	4	8	3	59	111	63	36	101	11	297	62	90	93	7	35	54	19	3	2	5	45	264	230	16	114	146	160	528	2455
34	4			2			6	9	3	22	5	1	4	4	20	19	31	90	2	118	36	30	28	1	22	62	7	5	8	6	4	73	19	2	8	7	30	51	787
35	82	1		25		1	31	21	32	2					19	41	24	79	3	63	34	23	19		27	16	5	2			17	83	153	8	116	21	88	46	966
36	75	15	8	8		6	13	8	4	2					20	29	4	37	6	20	36	23	23		17	9	5		5		24	101	150	14	10	9	16	9	697
37	18	6	18	49			17	5	4	1				7	13	20	25	62	4	46	22	34	16	1	9	15	4	4			8	3	92	7	63	8	4		582
38	14			3			7	4					3	10	11	23	16	37	3	31	12	5	10			8	6	2			3		811	61	157	20			1259
TOTAL	233	37	96	322	24	15	140	76	50	42	16	13	12	92	323	398	237	814	44	1091	384	291	293	26	166	224	68	16	18	11	779	3320	3209	1005	1207	894	906	949	17835

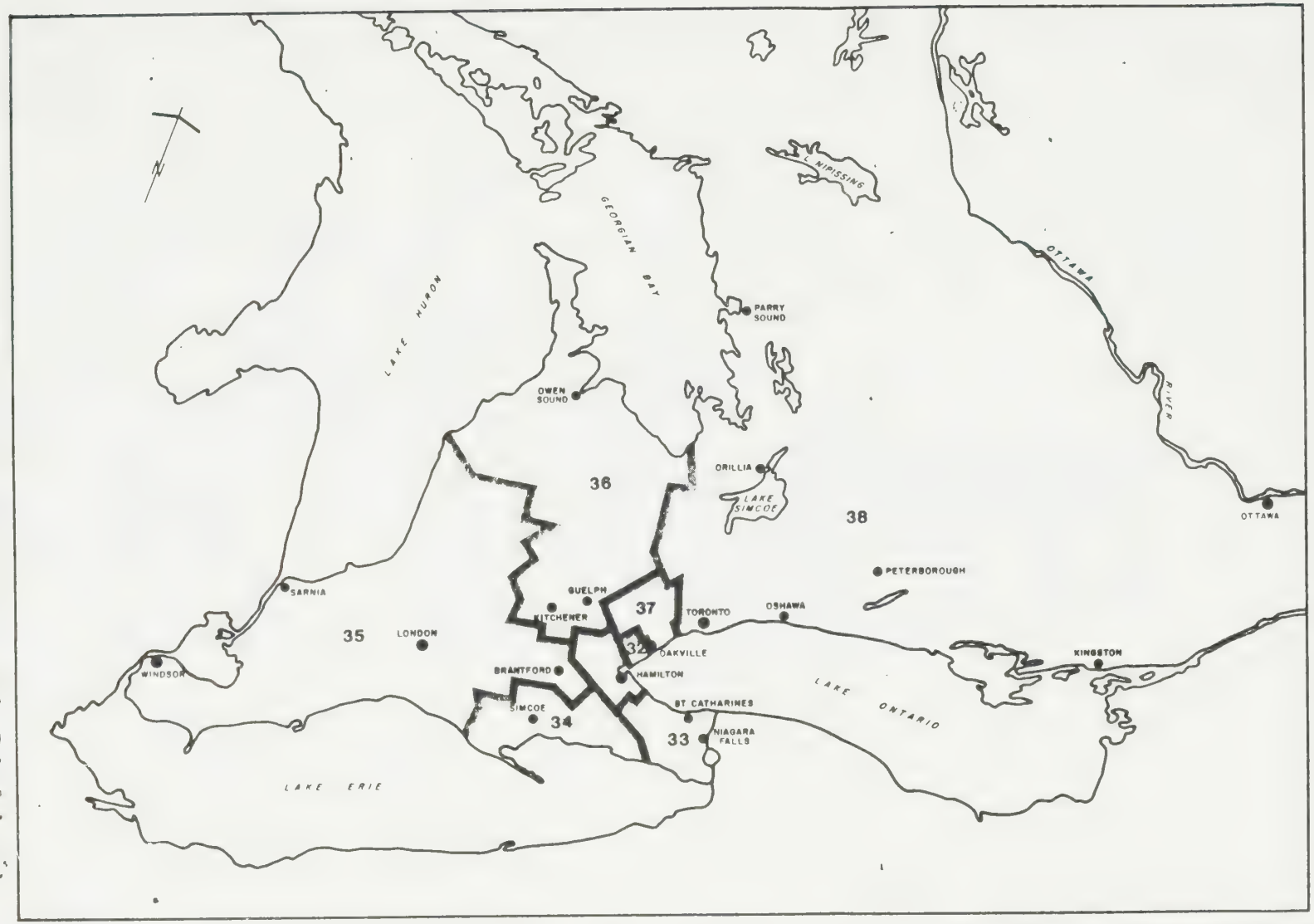
1. ZONE SYSTEM SHOWN IN FIGURE D-1 AND D-2

2001 FORECAST ORIGIN-DESTINATION TABLE (PK. HOUR)

VEHICLE DESTINATION ZONES

VEHICLE ORIGIN ZONES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	TOTAL
1																															18	69	11	7	77	133	42	6	363
2																															9	61	3		7	44	8		132
3																															21	157	11			13	26		227
4																															69	292	8	3	24	27	116	2	240
5																															29	119	1		1				150
6																															16	80	5		1	43			145
7																															42	178	17	7	43	24	16	6	333
8																															12	52	8	10	25	11	3	1	122
9																															17	73	21	54	109	19	14		307
10																															8	46	19	268	11	3	16		370
11																															5	27	10	11					53
12																															6	22	17	4					49
13																															15	110	89	195				10	419
14																															93	367	533	145			16	102	1282
15																															73	464	232	74	64	134	34	17	1083
16																															171	717	42	29	83	74	36	21	1173
17																															100	431	18	56	56	5	23	9	697
18																															442	2048	202	264	465	153	229	83	3931
19																															22	107	9	3	9	13	3	1	167
20																															293	1754	175	124	122	34	46	32	2580
21																															96	483	36	41	63	55	26	8	807
22																															112	669	66	35	44	43	38	3	1000
23																															111	633	183	170	127	106	71	10	1411
24																															2	21	6	3					32
25																															38	148	28	33	64	26	15		353
26																															34	167	81	248	39	69	42	12	692
27																															8	36	16	6	9	4	7	4	90
28																															10	30	9	36	19		93	11	208
29																															9	30	3	56		30			128
30																															10	56	70	201					337
31	30	16	37	102	38	13	60	29	10	5	6	3	25	19	48	113	63	157	15	36	61	82	76		37	40	18	22	17	2		860	60	12	81	134	16	25	2363
32	131	71	210	429	151	55	236	112	35	22	67	20	230	19	444	464	257	653	61	223	315	625	655	5	173	178	93	96	90	24	1023		954	307	398	591	4		5421
33	6	2	8	16		3	23	17		6	7	2	46	45	161	28	85	44	8	120	17	44	60	8	20	29	21	20	2	37	56	516		27	208	233	292	550	2807
34	3			1			6	6	1	7	7	1	17	2	31	5	16	37	1	45	11	12	12		16	33	3	23	24	16	5	202	19		16	20	56	48	701
35	31	2		11			38	23	19	2					29	20	44	47	2	33	9	13	15		20	12	4	24			24	205	142	15		47	186	84	1101
36	86	65	59	76		9	35	9	6	12					90	64	25	134	13	42	102	32	238		54	17	11		75		69	896	776	57	132		182	47	3392
37	111	7	19	54			42	6	5	1				12	15	19	34	71	4	73	7	28	52	2	11	17	3	49			29	11	334	45	312	55			1432
38	4			2			5	2					11	5	12	6	44	9	1	13	2	1	8			4	2	10			4		611	63	234	34			1087
TOTAL	402	163	383	691	189	80	445	199	75	55	87	26	329	202	830	719	568	1162	100	586	524	837	1016	10	311	330	155	244	208	79	3067	2122	4826	2442	2043	2227	699	1152	41481

1. ZONE SYSTEM SHOWN IN FIGURE D1 AND D2



LEGEND

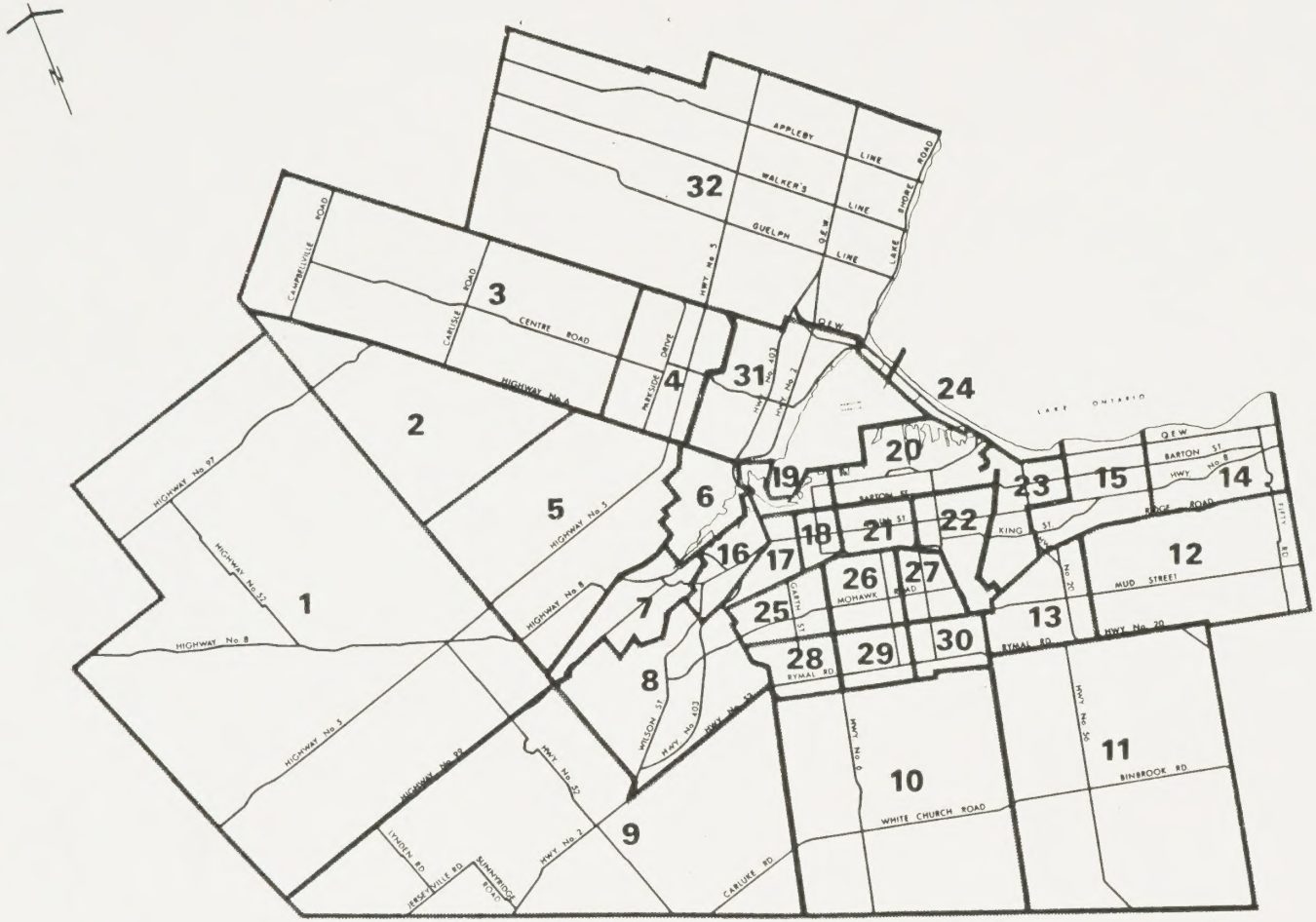
ZONAL BOUNDARIES

LOCATION OF INTERNAL MACRO TRAFFIC ZONES

EXTERNAL MACRO TRAFFIC ZONES

Nov. 1978

Planning & Development Department
Hamilton-Wentworth Region



LEGEND

ZONAL BOUNDARIES

INTERNAL MACRO TRAFFIC ZONES

Nov. 1978

Planning & Development Department
Hamilton - Wentworth Region